Jason Knuth, Komatsu Mining, USA, provides an insight into how miners measure the success of their operations, and notes the importance of avoiding irrelevant tracking metrics.
Mining operations currently face a vast number of challenges including social and regulatory responsibilities, workforce optimisation – developing new skill sets without losing valuable experience – and increasingly difficult mining conditions. With these new and growing challenges, mines are looking for new solutions. They are looking for ways to break down the factors that drive their production cost.

In talking with customers about the variabilities they face and figuring out the best ways to deal with these challenges, one metric is leveraged to truly understand the health of the operation: cost per tonne. Operations leverage this key performance indicator (KPI) to set their operational goals even as commodity prices fluctuate, as it is truly the marker most critical to their financial success. Safety will always be a measure beyond monetary cost, of course, and is always the top concern of a mine, with cost a necessary second.

At mine sites, there are typically two main areas that drive the cost per tonne KPI. One factor is total cost of ownership (TCO) of the mining equipment: how much does it cost to operate the equipment per hour in the operation? Factors that can affect the TCO include the cost of repair and maintenance. Having a better understanding of when equipment should be maintained helps reduce the likelihood of more costly maintenance down the line. For this, we are focused on driving down the operating cost to lower the cost per tonne. It is also important to understand the productivity of the operation, measured in tonnes per hour.

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Avoiding the data swamp

Within a single operation there are various types of mining equipment that may each have different functionality critical to the operation. The industry trend has been to get as much of the equipment connected as possible to get more data flowing to an operations centre where oversight on performance and alerts can be applied. In this model, operations will leverage a data lake or centralised repository that allows storage of all structured and unstructured data at any scale.

But just having more machines connected does not mean one will be able to glean valuable insight. To use this approach most effectively, operations need to leverage the use of data and a fuller operational picture with a specific goal or target in mind. This will help determine what data are needed and what data are just noise. If an operation collects data just to fill their newly developed data lake it will quickly turn into a data swamp, returning little to no value back to the operation.

Customising solutions

To pull the most value out of connected equipment and engaged onsite personnel, the following three-pronged approach can be implemented in any operation. It starts with the connected machines and products across the mine. Then the necessary information is extracted to be able to describe and measure the operation to determine a performance baseline. Then, with a specific operational goal in mind, processes can start to be optimised.

Komatsu calls these smart solutions offerings, which are customised for each operation leveraging smart connected equipment, enriching data using Komatsu’s analytics platform and then applying engineering knowledge to feed machine and system insights back to the operation.

But once the data are readily available and an operational goal is in mind, how can the specific challenge be broken up into manageable pieces? The best approach has been to start with measuring the operation’s health to establish the baseline. That way, as changes are made – empowered by data-driven decision-making – operations can easily see and understand if they are having a positive or negative effect on the problem at hand.
Starting with ‘what has happened’, as seen in Figure 2, the first step is a descriptive approach to generating reports and insights based on past events. From this one can evaluate potential opportunities to prevent these situations or bottlenecks from occurring. This will become the justification for moving forward with an initiative, because the potential business impact is measurable.

From there, one can determine the best methods for alerting and monitoring in near real time to understand ‘what is happening’, and enable quicker actions to be taken. This increases the responsiveness of the operation as there is a consistent use of the data – no more waiting for the monthly or weekly reports to see something that should have been done.

The largest impact often comes from enabling the right systems, processes and procedures to allow operations to determine ‘what will happen’, in order to prevent time and money consuming situations from ever occurring. First, statistical and physics-based models are established that will describe the behaviour of the machine or system, then live data are fed into the models to make a prediction of what will happen based on past information. Comparing the differences, anomalies can be detected in the system’s behaviour and personnel can be alerted to make corrective actions.

**Using data to re-engineer and reduce maintenance**

An example of this full process in action was recorded at an underground coal mine that had been seeing increased maintenance costs. The mining conditions had become more difficult, which was leading to a reduction of life on components. The resulting increase in parts and labour costs was directly affecting the cost per tonne of the mining operation. One of the most impactful costs recorded was for maintenance on the traction gearbox of continuous miners onsite. In the increasingly challenging environment, the continuous miner’s gearbox was seeing an increase in anomalies, impacting maintenance costs and operational downtime.

Onsite service personnel contacted their smart solutions analytics team to start investigating the data to determine ‘what has happened’. Multiple sets of sensor and operational data were reviewed around the anomalies, but at first pass the detection of these occurrences was not obvious. The engineering team provided some guidance and insight and were able to come up with additional calculated metrics. With these new metrics, advanced modelling techniques could be used to identify the beginning stages of this abnormality days prior to the event.

Deployed to the Komatsu system, this model then tracked ‘what will happen’. With the near real time data coming in, actionable alerts could be delivered to personnel to describe ‘what is happening’. But even though there was now a model to alert people to help reduce unexpected downtime, the mining conditions were not getting easier. That model and data were taken back to Komatsu engineering teams for a redesign of the gearbox. Adapted to the challenging conditions, the new design performed much better, helping the customer optimise their cost per tonne.

**Conclusion**

By approaching each mine’s challenges with an eye to specific metrics and an end goal in mind, mine sites can stay above the data noise and determine specific actions that can be taken to achieve the target. Working together to determine what that target is and how it affects the business’s bottom line unites all stakeholders in leveraging data most effectively. This is by no means the only potential path to success or process to be followed. Data solutions for mining are a rapidly growing, ever-changing space with new technologies introduced every day. To avoid getting lost in the numbers and the possibilities, the most important thing to do is to start following a process and continually grow the process with every challenge faced – adapting the operation, personnel and equipment to the increasingly challenging conditions in a way that keeps cost per tonne at the forefront of one’s mind.