



THE IMPORTANCE OF ECONOMICS IN MINING

Darren Rostron

Product Manager - Financial Solutions, RPMGlobalGlobal

Abstract

With the mining industry at a point of inflection - or perhaps introspection - many companies are placing a much greater focus on costs. Whilst the need for cost control is no doubt important, attention should be given more broadly to the total economics of our mines and projects.

Understanding the fundamental economic principles associated with mining is vitally important right now if we, as an industry, are to take control of our future and avoid the rollercoaster ride we have experienced in the past.

This paper explores how economic principles such as supply and demand and marginal analysis are necessary tools in both strategic and tactical mine planning. This paper also explores how specialist economic based systems and processes are needed to provide mining professionals with the essential information needed to make accurate economic decisions for our mines.

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Introduction

Over the past decade, the mining industry has been swept up by a wave of demand. The flexing of powerful economies have been tidal forces that, along with the growth from emerging markets, have delivered a tsunami of opportunity and wealth. "Bigger and better" drove investment and development, and miners who moved quickly were rewarded with the bulk of the catch.

As an industry, this boom was unprecedented, both in size and endurance. As an industry, we have been fortunate to reap rewards for our investments. By any measure of accounts, we have been successful.

As an industry though, the focus has been so laser-like on production that we seem to have lost the art and understanding of economics and efficiency. Now, though, demand has slowed. Bigger is no longer better and greater capacity on its own may no longer produce greater profits.

"The economics of mining are changing fast. Industry economics are at an inflection point... In this changed world the winners will be the ones who understand the economics of their mine and can adapt and change to maintain and improve those economics." (Runge, I.C.:2012)

We must find a new way to get greater certainty, reduce risk and tighten our control. A new way doesn't necessarily mean discarding the past. Rather, it means applying tried and tested methodologies in innovative ways.

This article will explore three of these methodologies further:

1. Strategic economic evaluation - exploring the economics of a project or operation;
2. Tactical economic decision tools - cost control and efficiency; and
3. The use of specialist systems and processes to aid the strategic and tactical methodologies.

Economics of the Project / Operation - Strategic:

On the path to rediscovering the power of economics in mining, we must look first at our strategic planning. Strategic planning in mining requires more than just running schedules and reviewing different sequences. It requires the interrogation of our strategic plans to find the efficiencies; looking at options by applying an iterative mine planning process² that, at its very core, relies on economic data at each stage.

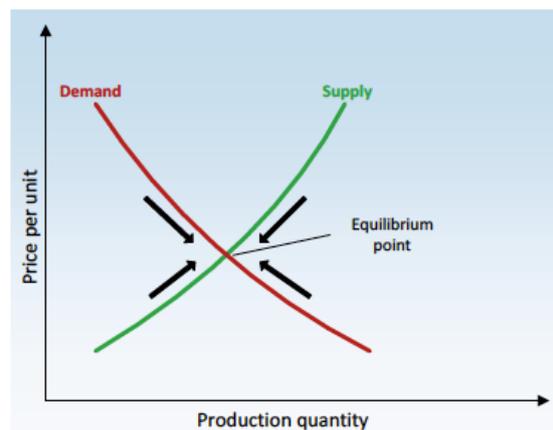
Supply and Demand Equilibrium

Before we look in detail at one of the strategic economic tools at our disposal - marginal cost and revenue - we must first refresh our knowledge of the underlying concept of supply and demand equilibrium.

The theory is that in a free market commodity based environment, where there is an excess of supply over demand

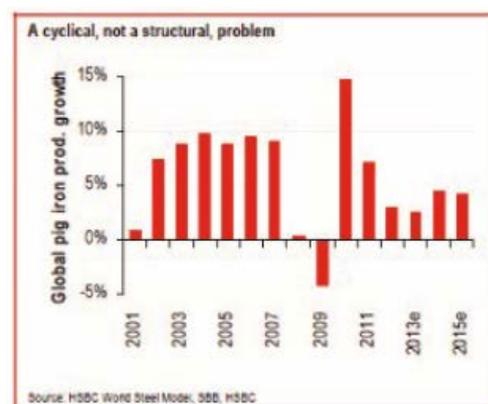
at a given price, suppliers will see a build-up of inventories. Suppliers will realise that the price is too high and must be lowered in order to attract higher demand. Suppliers start to undercut each other in order to reduce their surplus inventories causing the market price to drop. This process continues until we see a match in the quantity of supply and demand for the commodity. In the same environment, where there is an excess of demand over supply at a given price, purchasers are willing to bid up the price of the commodity to ensure they receive access to the product. This drives an increase in the market price for the commodity. The increased price attracts an increase in supply from existing suppliers and new suppliers into the market. This process of bidding up prices and the ensuing increase in supply continues until we see a match in the quantity of demand and supply for the commodity.

The supply and demand equilibrium can be visualised as curves as shown below.



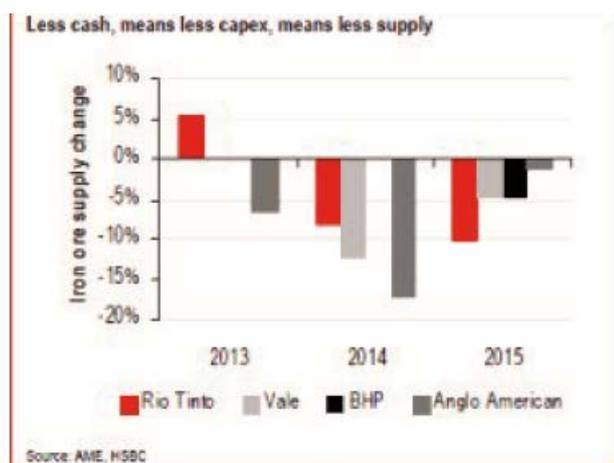
It is clear that for most of the commodities produced through mining, we have been in a position of high demand and under supply for the last decade or so, resulting in the prices that we have come to enjoy. However, it appears that the forces of the free market are working to bring equilibrium and hence we are seeing the lowering of certain commodity prices.

The change in demand for bulk commodities such as Iron Ore and Coal can be seen through the various research and forecasts published recently. HSBC in their recent Metals Quarterly³ publication are forecasting a slowing in growth of global pig iron production - noted in the chart below - which would lead to a reduction in iron ore demand.



If the theory of supply and demand holds true, then this predicted reduction in demand would lead to a reduction in the price of iron ore. Further considering the supply and demand equilibrium theory and the lowering of forecast prices, HSBC have also lowered their expectation of iron ore supply over the next three years, as noted in the chart below.

So where on the supply and demand curve will we be over the next decade? Will we continue to prosper with high demand and high prices? Will we rush headlong into an over-supply situation? We as an industry can control our future with the decisions we make now!



Marginal Costs and Revenues

Those decisions are the strategic decisions that we make when looking at new projects and expansions or even the deferral of projects that have made headlines over the past few months. The plans for these projects must be balanced between the drive for production and the economics and efficiency of that production.

One of the key theories that help us to understand the economics of these projects is marginal analysis.

"In economics, few concepts are more important than the concept of marginal cost." (Runge, I.C.:1998:40)

The marginal cost of an expansion is the difference in total cost from the current operation to the expanded operation. We must compare the marginal cost of an expansion to the marginal revenue that the expansion produces. Marginal revenue is the change in total revenue. The essence is that if the change in total revenue does not exceed the change in total cost, then the expansion project is not viable.

With demand for certain commodities far exceeding supply over the past decade, driving very high commodity prices, the additional or marginal revenue has in many cases outweighed marginal cost. But as this supply is growing and demand is weakening, the additional supply from an expansion could in fact create an over-supply situation and result in a reduced selling price for all production.

The table left shows how an increase in supply from an expansion that reduces the selling price for all production can still create an increase in total revenue for that operation. But when you investigate further with marginal revenue analysis, you see that the marginal selling price for the additional production is much lower than the estimated selling price per unit.

Applying the same concept of marginal analysis to the costs of the project, provides highly valuable information into the decision making process.

Let's say for example that the marginal cost of the expansion under investigation in the table has been calculated as \$125.00 per unit of production. At face value, it appears that the expansion will return a positive cash flow

(\$20.00 per unit being revenue of \$145.00 per unit less cost of \$125.00 per unit). However, when comparing the marginal revenue (\$105.00 per unit) to the marginal cost (\$125.00 per unit) you can see that the expansion will not provide additional value to the operation - worse it will destroy value.

Cost Control and Efficiency - Tactical:

Equally as important as strategic planning, is to understand the use of economics in our short range tactical or operational planning.

When we take a short range, tactical view of our mines, we tend to focus heavily on production indicators and little on economic indicators. In fact, due to the high fixed cost nature of mining, the need to focus on production is actually driven by the underlying economics. However, it is vital that we do not ignore the economic indicators and ensure we meet our production targets efficiently.

Mining is an industry that incurs a relatively high proportion of fixed costs against variable costs. The fixed costs can be attributed mostly to the key resources for the business which are people, equipment and infrastructure.

It is important to note here that when considering economic evaluations, the classification of an item as a fixed or variable cost may well be dictated by the timeframe covered by the evaluation. In this short range tactical view, people, equipment and infrastructure are usually considered fixed costs. However, in a strategic evaluation, these items may correctly be considered as variable.

So the focus on production and equipment utilisation in short range tactical plans must still be fundamentally based on economics, by efficiently utilising the fixed costs - people, equipment and infrastructure - whilst managing the use of discretionary variable costs. It is not a case of production at all costs. It is a case of finding the most efficient economic level of production by applying the iterative mine planning process even in the tactical planning timeframe.

This leads to two key tactical tasks that keep us efficient and profitable during times of reducing commodity prices:

1. Plan compliance; and
2. Managing variable costs.

Plan Compliance

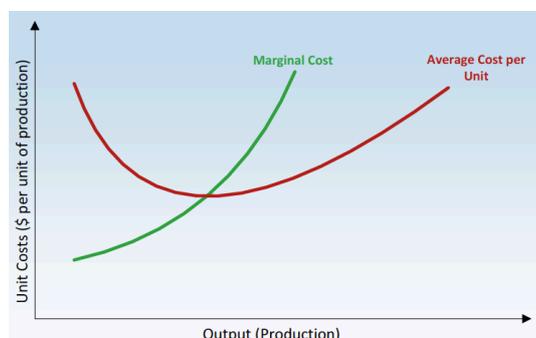
Given the effort and investment placed into finding the most appropriate economic plan, it is vital that we comply with this plan during execution in the tactical short range horizon. Complying with these plans enables us to not only meet our strategic goals, but importantly, enables us to utilise the fixed costs efficiently.

Variance to plan - be it increases or decreases in production volumes and grades, or even spacial variance - typically results in a loss of economic value for the operation. Assuming of course that the plan itself has been the culmination of an iterative process that evaluates numerous options before settling on the most economical of those plans.

By compliance to plan and utilising the fixed costs efficiently we are driving down the average unit cost of production towards the optimal level. This is very important in a time of uncertainty in commodity prices.

Managing Variable Cost

The marginal cost economic concept noted above is also an extremely valuable tool when applied in the short range tactical horizon in order to manage variable costs. If our goal is to bring our average cost per unit of production down to the most efficient point, then marginal cost can be used to evaluate if the variable cost of the next unit of production is lower or higher than the average. If the marginal cost is higher than the average then adding that production to the plan will in fact increase the average and move you away from the most efficient point. This can be demonstrated with curves showing average and marginal cost per unit at a given level of production (Runge, I.C.:1998:41). Managing variable cost in the ultra-short term horizon is the most effective way to comply with the financial plan. This requires accountability and decision making.



Systems and Process:

Both the strategic and tactical plans require decisions to be made. Decisions are made by people; not by computers.

Good decisions can only be made if the person making the decision has the appropriate level of information available to them. To achieve this, we must make more effective use of systems and processes that have shown their fundamental reliability.

This is particularly important in the mining industry. Different to a lineal manufacturing environment, mining is dynamic. To produce the same level of output next year and the year after as is currently being produced, will likely require a very different set of production activities, creating a different cost profile.

This requires the use of specialist planning systems that: firstly, take into account the dynamic nature of the mining industry; secondly, allow for an environment to review the multiple options being evaluated through the iterative planning process; and lastly, are based on the fundamental economic principals of mining.

In the book "Good to Great"⁴, Jim Collins outlines what he calls the "Hedgehog Concept". At its core the Hedgehog Concept is an illustration of the need for companies to concentrate on a core competency, if they wish to become a great organisation. One of the characteristics of a good company that succeeded in becoming a great company, according to Collins (2001), was that it had dedicated itself to a single competency at the apex of economic drivers, passion and potential.

"The good-to-great companies are more like hedgehogs - creatures that know "one big thing" and stick to it. The comparison companies [that failed to make the grade] are more like foxes - crafty, cunning creatures that know many things yet lack consistency." (Collins, 2001:119).

Collins wrote of companies, but it applies equally to solutions. To reduce technical risk, we must look towards solutions that are themselves akin to hedgehogs - very good at the thing that they do. This absolutely does not mean that integration is not vital - it is, but rather that each component of the whole must be itself the best solution - the solution that knows "one big thing."

To reduce risks, we seek expert advice. Why then, would we not seek expert tools and place them in the hands of expert people?

Of course, in many cases, companies already understand this. Over the last decade, it has been less difficult for engineers and accountants to access the funds needed to expand their capabilities.

However, the high commodity prices experienced over the last decade or so have led to a generation of mining professionals that have been focused on production and expansion, with little exposure to the underlying economic fundamentals. There has been a generation not exposed to economics of cost control systems and processes; of developing an economic plan and compliance to that plan; of efficiency and the importance of cost per unit of production.

To reduce project technical risk, we must rely on expert advice. But while the industry counts many experienced mining professionals, it has fewer now with the experience to manage the current financial reality.

The answer is the virtuous circle: rely on those gurus that exist to share their knowledge with others, who can in turn not only pass that knowledge on, but build and expand upon it.

Conclusion

We have experienced a decade or more of unprecedented commodity prices. During this time we have invariably turned our attention to maximising production. We have seen recently that this push for production, along with a softening of demand, is moving us back towards an equilibrium point in the supply and demand curves. Our task now is to refocus our attention on fundamental economics in both the strategic and tactical horizons, supported by great expert systems and processes.

We as an industry can continue to prosper by embracing economics as the basis of our decisions being made now and into the future, even with the uncertain times that may be on our doorstep.