Productivity in mining

A case for broad transformation

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Building a better working world

Productivity, on both a volume and cost basis, has been declining significantly in the mining industry since 2000. This has been a conscious choice by industry participants to pursue production growth and headline revenue during an unprecedented boom in commodity prices.

Many companies have been dealing with this substantial drop-off in productivity through a series of cost-cutting exercises or point solutions. However, the size of the problem is too large for point solutions to solve on their own and often they have the effect of simply moving the problem further down the supply chain. Real and sustainable productivity gains will only come from broad business transformation.

Why the need to boost productivity?

1. To regain ground lost over the super cycle

EY, in collaboration with the University of Queensland in Australia, has undertaken more than 30 hours of in-depth interviews with senior executives in the mining industry, who recognize that the focus on volume at any cost has led to inefficient practices in terms of productivity. As one executive commented, “Some activities we were doing reasonably well in the past have gone backwards. We were a little more entrepreneurial and innovative in what we did. The last decade has taken some of that out of us.”

Identifying inefficiencies can be confronting. How do we unlock the knowledge of how we were more productive in the past? Behavioral change is critical given that many mine managers, frontline engineers and operations supervisors appointed to these positions during the super cycle have never operated under a marginal environment.

2. To continue to innovate to recover lost competitive advantage

Many mining economies (Australia, Chile, South Africa, etc.) have relied on currency movements to retain comparative advantage. Exchange rates have generally been positively correlated to metals and mineral prices. However, the massive quantitative easing that central banks have used to reboot economies has upset this relationship. With lower prices and stubbornly sticky exchange rates, producer countries have begun losing their comparative advantage, and hence producers in these countries need to innovate in order to become more competitive and reach new levels of productivity.

The mining industry spends very little on research and development for innovation compared to other sectors, especially on mining and processing methods. In fact, the last major investment in process technology was back in the 1970s when mining was booming and the Australian mining industry invested in gold extraction process technology, which transformed the industry. Given the right levels of investment, significant gains should be possible through innovating mining and processing methods, perhaps in conjunction with original equipment manufacturers (OEMs).

3. To counteract rising real wages

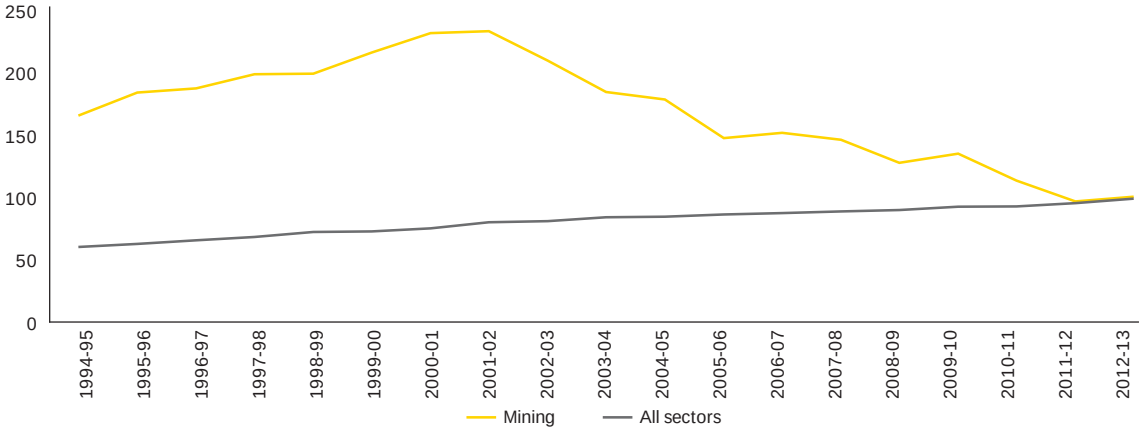
For many developing economies, low-cost labor was used as a means of comparative advantage. Mine plans that optimized through more labor were developed as it provided a cost advantage over production elsewhere in the world. However, many of these economies have been so successful in generating increases in growth that this has fed into increases in real wages (significantly above the rate of inflation). Without commensurate increases in productivity, mine plans of many of these operations in these countries will not be sustainable. Ultimately, more automation will be required but this will create its own set of political challenges.

How large is the issue?

Productivity is often ill-defined as more output for fixed input or the same output for less input. In our opinion, productivity gain should be measured as a form of optimization, i.e., the highest ratio of output to input, which could in fact mean achieving higher productivity with lower input.

Over the broad spectrum of different mining operations, it is difficult to define the size of the productivity problem. To overcome this, economists typically measure productivity across a range of factors referred to as multifactor productivity (MFP), with the most common factors being labor, capital and materials. For example, the Australian Bureau of Statistics measures MFP as output per unit of combined inputs of capital and labor in conjunction with other technological and organizational factors. The following chart shows that labor mining productivity (in Australia) has declined by roughly 50% since 2001.

Mining labor productivity in Australia declined by roughly 50% since 2001



Source: Australian Bureau of Statistics

This decline has been over a period when we have seen:

↑ Contributing to improved productivity levels	• Great improvements in equipment efficiency and reliability, demonstrated by the year-on-year improvement in technical efficiency levels • Investment in the sector by OEMs producing higher quality equipment • Engineering advancements in the sector
↓ Reducing productivity levels	• Diseconomies of scale brought on by fast (but not necessarily efficient) expansion of operations • Ineffective utilization of key inputs (labor, equipment, etc.) • A move to reinstate silos to manage size, scale and complexity

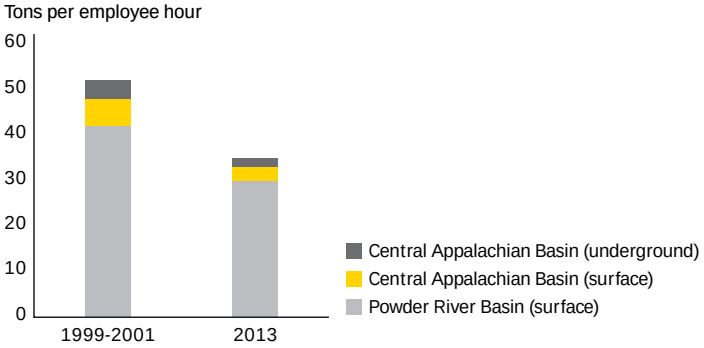
Clearly, without this investment in the sector the MFP decline would have been even greater. In the long term, technical innovation needs to enable miners to achieve greater productivity, rather than solely enabling growth. This may mean greater collaboration between miners and OEMs to achieve the levels of innovation required for long term success.

Labor productivity – a major contributor to the decline

Labor productivity in the mining industry has been declining rapidly around the world. In the US coal sector, for example, labor productivity declined by an average of 27.5% from 2009 to 2012. If we remove the Illinois Basin, the only area to see productivity improvements during this period, from our calculations, the average labor productivity decline was 44%. While better technical efficiency and technological advances mean organizations should get more out of the ground with less people, average employment in the US coal sector increased by 11% during the same period.[1] This is partly due to the increasing complexity of operations, but realistically we believe it is due to inadequate skills mix brought on by the skills shortage in the boom time.

Research undertaken by Doyle Trading Consultants[2] has identified an inverse correlation between coal prices and productivity stretching back to 1949, which was echoed by one of our

Decline in US coal labor productivity – 1999 to date



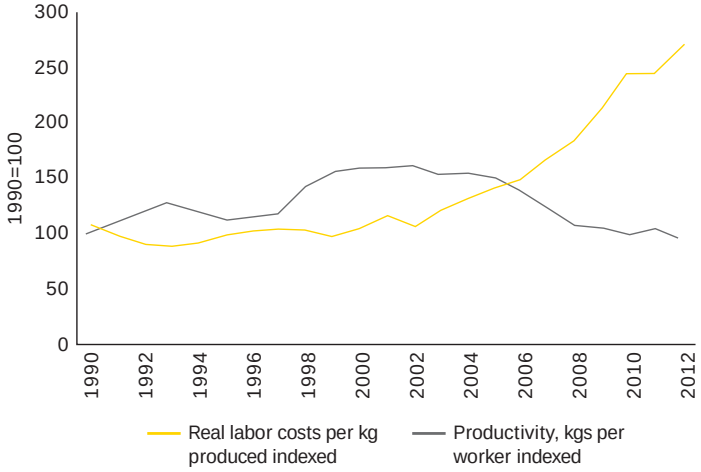
Source: Data sourced from "US coal industry challenged by over a decade of declining productivity," SNL Financial, 6 March 2014.

1. "US coal industry challenged by over a decade of declining productivity," *SNL Financial,* 6 March 2014.
2. "US coal industry challenged by over a decade of declining productivity," *SNL Financial,* 6 March 2014.

interviewees: “When prices are through the roof, you start building inefficient practices in terms of productivity.”

In emerging markets, many countries are seeing labor costs rise way above the rate of inflation. In South Africa, for example, labor costs currently range from 20%–25% of total production costs for modern, mechanized and open cast mines, to 50%–60% for the mature deep-level underground mines. Worker demands for increased salaries and wages have continued to plague the industry, and it is estimated that South Africa’s mining industry lost more than US$1.4b in the 2012–13 financial year. While workers may aspire for higher real wages, during weak commodity price cycles the dialog should be focused on achieving productivity improvements to pay for this. In contrast, a notable and sustained decrease in labor productivity has been experienced in the country. Research by CoMSA, for example, indicates that since 2007, labor productivity in the gold mining industry, expressed as kilograms produced by employee, declined by 35%. Clearly, this is not a sustainable situation.

RSA gold mining, labor productivity (kgs produced per employee) and real labor costs per kg of gold produced, with base indexed to 1990

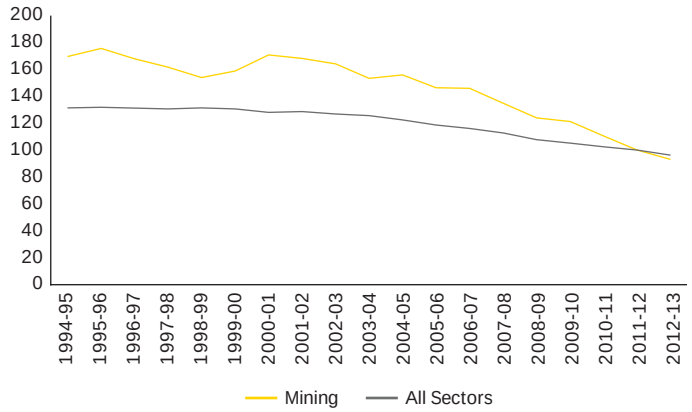


Source: Statistics SA

Capital productivity – not seeing the investment

Capital productivity has been on the decline over the past decade. For example, in Australia it has dropped by 45% since 2000 (versus 22% in all industries). Capital productivity is impacted by the long lead times between investment and production, as well as by the following contributing factors:

- Ineffective portfolio management (not having a balanced set of projects in the portfolio)
- Issues with capital allocation decision-making - rising prices always justified applying more and more capital to the challenge to increase production, rather than looking to optimize the capital already applied
- Resource nationalism affecting owners’ anticipated rate of return
- Increasing technical difficulty - going deeper in more remote locations
- Lack of organizational capability at owner and at contractors, i.e., access to skilled labor and access to skilled management is a challenge caused by the increasing number of projects globally, increasing technical difficulty, and the retirement of a generation of professionals
- Poor project execution - schedule delays and cost over runs
- Slow pace of innovation in mining technology
- Lower levels of substitution of capital for labor than that of other sectors



Source: Australian Bureau of Statistics

Industry response

Many economists believe that this issue will resolve itself, and hence no action is required. As new projects come online and the hunt for skilled resources eases, there will be a natural correction in the macroeconomic picture and unprofitable operations will close or go into care and maintenance. However, to be competitive and focused, action is required over a significant period to address the productivity opportunity at a company or microeconomic level.

Many of our clients have been successful at reducing costs through conventional means, such as:

- Renegotiating with contractors on rates
- Reducing support staff from back office
- Delaying or suspending projects
- Selling off underperforming assets
- Implementing continuous improvement programs
- Improving equipment utilization and reducing cycle time

Cost reduction initiatives

Company	Program
BHP Billiton	• As part of the productivity agenda, the company has put all of its operations on a common information management platform. The aim is to replicate best practices and improve operational performance across the Group. By generating more volume from existing equipment and lowering unit costs, the company was able to reduce the controllable cash cost by US$2.7b in the 2013 financial year. • To enhance higher return on investment (ROI) on incremental investment, BHP Billiton has increased competition for capital and is driving down project cost. A 25% reduction in capital and exploration expenditure is planned for 2014.
Rio Tinto	• Rio Tinto has launched a new phase of its "Mine of the Future" technology and innovation program, which is driving value by optimizing the performance of key international copper and coal operations. • To enhance returns, the company is divesting operations that no longer fit its strategy of focusing on high return assets. It is expected to raise US$3.3b through announced or completed divestments by 2014.
Vale	• To focus on capital efficiency, capital and R&D expenditures are trending downward. Vale, which spent US$18b in 2011, has budgeted US$14.8b for 2014 and intends to trim it down further to US$10.4b in 2016. • The company plans to divest non-core assets, is open to partnership in selected businesses and assets, and is creating an environment of stronger internal competition for projects funding.
Norilsk Nickel	• Norilsk Nickel has unveiled a new strategy to focus on capital discipline and ROI: all production assets in the company's portfolio must meet defined "tier-1" asset criteria by 2015. The company classifies projects as tier 1 if they are large scale, deliver greater than US$1b in revenue, have an EBITDA margin greater than 40% and have a reserve life of more than 20 years.

Source: Company presentations and press releases.

Need for longer-term focus

Many of the executives who were interviewed said that through cost-cutting exercises, they are now much more focused on attaining and sustaining profitable growth rather than volume.

However, there is a need for a focus on longer-term initiatives which, while being harder to execute, will have more impact on improving overall productivity as defined below.

There is a growing realization that enabling fundamental improvements in the organization requires a shift in corporate culture (defined as "the way we do things here"), as well as organizational structure and accountabilities. A refocus on business improvement across the organization is needed. One of the interviewees said, "It's not a matter of getting people who have actually lived and breathed operational excellence. Its people who have done that but also have the mental processing ability and the leadership skills to be able to take an organization along as well." Getting the right skills mix, the right culture and the right measures is the key to long-term success.

Many survey respondents recognized that due to the prevailing skills shortage in the boom time, many people who are currently in the sector do not have the right skills to operate under a cost-constrained environment. And indeed, labor inefficiency in large operations is a major cause of productivity problems. Anecdotally from the interviews, the greatest challenges identified are with experience, coordination and supervision, and so a higher level of skills development is needed to enable long-term success.

Urgent need to adapt

Companies need to adapt quickly to the changing environment or risk becoming non-competitive in an ever-competitive market. Once the world's dominant gold mining industry, the South African gold mining sector slipped to sixth, behind China, Australia, Russia, Peru and the United States in 2013.[3] In the 1970s, the country produced almost 80% of the world's new mine supply, and until 2006 was the world's largest gold producer. However, in 2013, the country reported a production of only 145 metric tons. The relative decline in global significance of South Africa's gold mining industry has been evident for some decades, where power and labor costs continue to soar against a backdrop of aging deeper (and therefore higher cost) mines.

> "Poor metals price performance had been exacerbated by significant cost pressures propelled in the first instance by rapid power price increases and productivity challenges which arose from the need for continuing above-inflation increases in labor costs while, as mines age, the ore mined is of lower grade, deeper and further from the shafts."[4]
>
> **Anglo American Platinum Chairman, Valli Moosa**

Burning platform – a need for broader transformation

As efforts to improve productivity have failed to get the right results, the issue has rightly been escalated to the CEO's agenda. Making productivity gains is not as simple as further cost reduction efforts. The length of the super cycle and the pursuit of growth led to the subversive change to the organizational DNA of many mining companies. Their structures, processes, performance measures and culture have all drifted to favor growth over productivity. The size of the problem is too large for conventional solutions to work. EY believes real productivity gains will only come from transformation. A narrow focus on point solutions or continuous improvement will not close the gap and could even be counterproductive.

The following example illustrates how a focus on cost optimization in one area of the value chain can be to the detriment of the total value chain:

When reviewing costs at a coal mine, the drill and blast operation was identified as having higher-than-benchmark unit costs. To reduce these costs, the quantity of explosive used per blast was lowered, reducing the total cost per unit tonne of coal produced. This action, however, reduced the fragmentation of the overburden, increasing the time required by the dragline to move this material. The overall result was that the drop in production rate decline more than outweighed the minor reduction in production costs.

What does broad transformation mean?

New ways of thinking need to be considered to analyze and assess the level of improvements the industry needs. This involves having one view of the world:

- A clear strategy based on a broad set of value drivers
- An operating model that is aligned with the strategy
- Integration and alignment across the value chain through process integration
- Standardization of work procedures
- Aligned planning, budgeting and performance measurement

3. "GOLD – Mineral Commodities Survey," *USGS,* 2 June 2014.

4. "Anglo American Platinum Limited Annual General Meeting," *AngloAmerican website,* http://www.angloplatinum.com/investors/invest_sub/display.asp?Related=true&Id2=577, accessed 15 April 2014.

To be effective, you need to be committed

Unfortunately, many organizations see productivity as a phase after the slash-and-burn of cost reduction and before the return to growth. When the focus on productivity is short term and/or temporary, it is unlikely that improvements will be sustainable. The quest needs to be long term and requires a change in culture across the organization from the boardroom to the pit.

Real and sustainable productivity requires a holistic and top-down approach that aligns productivity activities to their strategic value and contribution, and they need to be planned and executed in a coordinated way across the value chain.

It is critical that all the systems, processes, interfaces and interlinks are well understood so informed decisions can be made.

This may require significant adjustments including:

- Changing mine plans
- Reassessing mining methods
- Making changes to equipment fleet and configuration
- Reducing production
- Increasing or reducing automation

Most of these have been untouched by cost reduction exercises.

The most successful companies in addressing the productivity challenge have the following traits:

- Are bold and not incremental
- Have a long-term vision and plan
- Take an end-to-end view
- Look for broad solutions
- Eliminate silos
- Align objectives to strategy
- Set consistent performance measures for productivity that create value
- Address the behavioral and cultural settings necessary for sustainability
- Learn from history, but be open to innovation
- Are deliberate in planning and executing their initiatives

We believe that to really address the productivity issue requires a "whole of business" or end-to-end focus. This will drive a multi-functional response to problems, break down silos and ultimately deliver unprecedented productivity improvements.

Many of our interviewees felt that they hadn't yet got this right, but the whole of value chain approach resonated with them; as one executive said, "it's about the systems and processes, it's taking a holistic view of the different parts and how they fit together." This isn't as easy as it sounds. Typically, the information and data needed to bring about this understanding is spread across the organization and differs greatly in terms of:

- Volume - how much data
- Variety - the type of data
- Veracity - how much it can be believed
- Velocity - how quickly it is generated

These four V's are the routine descriptors used to codify a big data opportunity which in turn demands a different approach to analysis and insight from this data. Good data is needed to understand what good performance and good productivity looks like. Many organizations are struggling with each of these measures. They lack the means to cope with the sheer scale of data flowing into the business and with the diverse nature of structured and unstructured data. While they understand that it is an advantage to turn data into insight quickly, they are intimidated by ideas such as real-time analytics. Nor do they always know which data sources are to be valued and trusted, when to question the insights generated, or which technological tools can help them with these concerns.

Key considerations to help you deal with your productivity challenge:

- Are you improving or transforming?
- Are your initiatives adding to the long-term bottom line or just moving the problem?
- Are you thinking about the problem conventionally or with a value chain view?
- If you are considering achieving higher productivity with lower input, do not forget to consider the impact on cash flow and profit. Reducing output may boost certain productivity measures but may negatively impact, e.g., ROCE.

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