

INNOVATION IN MINING – ARE WE READY FOR A NEW PARADIGM?

It is trite to say that these are challenging times for the industry. Each of us would at some recent point in our careers have bemoaned volatile commodity prices, challenging labour, social and investor issues, policy and regulatory uncertainty, and the difficulty of achieving zero harm. We don't mention the upsides too much. But let's face it, mining can be immensely exciting and rewarding precisely because of all these big challenges we have to overcome.

Henry Ford once said: "If I had asked people what they wanted, they would have said faster horses." Well, he didn't take their advice but went on to redefine the modern production line – driving efficiencies and reducing costs to make the model T car affordable for all. Interestingly he did this while paying his employees almost twice as much as his competitors.

Don't worry, I am not going to talk to you about slow horses – or fast cars for that matter. But I do think this little story conveys an important lesson – that the big step-changes in industrial history were never achieved by only applying conventional wisdom and incremental change. Instead, it took bold leadership, foresight and innovation.

Tonight I want to explore innovation and use of technology a little further and consider whether the innovation we see in mining is really leading to a new paradigm for the industry.

Let's start with the obvious. We know we cannot reach our potential as an industry and a country if we stay exactly where we are. To me it sometimes appears that all the industry players: labour, capital, management, communities and regulators - are in a perpetual arm wrestle with each other. Year after year we repeat the same zero sum game where a "win" for one group is too often seen as a "loss" for another. Higher wages are a "win" for the workers who keep their jobs and a "loss" for investors; higher profits are a "win" for investors and for the tax man, but many believe it's at the expense of workers. This destructive dynamic is as much about collective culture, lived experience and navigating our ever-present history as it is about the facts or the situation at hand.

So are we trapped in an outdated paradigm when we think of South African mining and can this change?

Firstly, let us consider previous fundamental shifts in South African mining. Recall how the industry changed completely with the death of "diggers democracy" in the late 1800's. Small claims holders

and prospectors were squeezed out of the Kimberley pipe by the creation of large mining houses. This revolutionised the industry and ultimately turned vast numbers of individual miners of all races into employees in racially-specified often dangerous jobs. They all worked for the large capital and technology intensive businesses which were needed to mine the enormous low grade gold deposits in the Witwatersrand conglomerate. This truncated history lesson brings us to the industry today.

My view is that South African mining is recognisably the same as it was 50, even a 100 years ago. We still require large amounts of often foreign capital, managed by a small professional class of miners - though increasingly diverse – but still directing very large numbers of low or semi-skilled almost exclusively black workers. Perhaps this is why today, 23 years into democracy mining in South Africa struggles to enjoy consistent political, social and investor support.

Compounding the historical issues are current realities: mining has become a lot more challenging as we go deeper and exploit lower grades and complex geologies while dealing with structural cost increases such as rising labour and input costs. Consequently, South Africa has lost its place as the pre-eminent mining jurisdiction in the world. We had minimal volume growth in the commodities boom – well behind Australia, Brazil and Chile - and our productivity lags behind them too.

According to PWC's September 2016 report on South African mining, input costs increased significantly more than the CPI. South Africa had the highest cost of labour as a percentage of total costs among the major producers, averaging around 60%, compared to the United States and Australia which average around 30-40%. EBITDA margins continue to decline with a reported industry average of 18% for 2016. This low EBITDA percentage, which serves as an approximation of cash earnings, is of course not sustainable. As a result funds reinvested were 32% of total value created – significantly lower than in previous years. This will inevitably slow our future growth.

Now it is not often mine management borrow phrases from Lenin, but let me deviate from tradition: ***“What is to be done?”***

To appropriate another currently popular sentiment – **we need some “radical” solutions**. But when we talk of solutions, we - and I mean everyone affected by the industry – do not have the same understanding of what counts as a win:

- Do we celebrate technological breakthroughs or fear they will result in job losses?
- Are staff an asset – or are they a cost?
- Do mines care about safety or do they only care for profits?
- Is increasing productivity worker exploitation or is it good management?

- By exporting commodities do we undermine industrialisation or utilise our competitive advantage?

How you answer these fundamental questions really does depend on who you ask and where you sit – it is about values, ideology and the divergent interests of our different stakeholders.

What is clear is that we need a fundamental change in the way we think and work if we are to unlock this conundrum. Perhaps technology, innovation and modernisation – and the management values needed to implement it - offer a way forward.

The question is, can we claim that our collective efforts to modernise the industry are really revolutionary? This, after all is what Henry Ford did for the motor industry.

Certainly, we have made huge strides in safety, efficiency and the adoption of technology. But more anomalies and conflicts are emerging that show that mining in South Africa no longer seems to work. We appear to lurch from crisis to confrontation as the commodity cycle - **or our stakeholders** - move against us.

So perhaps we can say that the fundamental sense of crisis that forces **fundamental change** – has not yet happened but, we all know it is inching closer.

Some believe that the current wave of technology-led modernisation is creating space for another paradigm shift capable of re-inventing the whole industry. But I don't believe we are nearly as far down this road as we might like to think.

Let's take one imperfect measure. According to the most recent published research from the Human Sciences Research Council, in 2014/2015 the South African mining and quarrying industries' spend on R&D actually decreased by 20%. This begs the question: are we focussed enough on creating the science to drive modernisation? Certainly we have seen some exciting developments – in terms of automation and data science for example. But relative to other sectors, with much larger R&D spend, progress is slow.

But for those who hope that technology is revolutionising South African mining - let's conduct a thought experiment and imagine for a moment what mining looks like in one generation if we continue the current rate of modernisation. Let us imagine for a moment...

The mining industry is driven by innovation with research and development spending exceeding other industry norms. As a result South Africa, indeed Africa's top technical and creative graduates leave university dreaming not of creating the next consumer app – but of solving mining's biggest challenges. All miners are highly skilled at interacting with technology – their pay and social standing reflects this. In fact, universities and TVET colleges deliver a steady stream of relevant technical and professional talent to the industry which is now an employer of choice. This is partly because projects like the waterless mine are so successful that environmentalists and community activists challenge heavy industry and agriculture to emulate the mining industry's stewardship of natural resources.

In this mining industry of the future, safety is not a bone of contention because zero harm is achieved. The government now asks our advice on how to improve safety on roads, in hospitals and in industry. South Africa is a world leader in exporting locally manufactured mining technology – which is why the DTI and DMR design ways to help the industry. Unions, workers and mine management don't have adversarial relations. Workers are represented on boards, share in profits and provide a steady stream of productivity enhancing ideas. Community cohesion is improved by the presence of mines. They, and government at all levels, court mines helping them grow just as mines help communities develop. We cut rock; we know what is there before we do so; and waste is something we go back and mine not something we produce - much of. Other countries visit us to learn best practice in legislation and regulation. This is why investors flock to South Africa and remain invested through the cycle as the industry utilises the country's extraordinary resource base to the benefit of all stakeholders. South Africans of all persuasions are proud of mining – and regard the Industry itself as a “National Champion”.

It's quite a dream and I am not the first to wish it were the current reality. Nor will I be the last. All the benefits listed above are in theory possible through broad modernisation - if this is embraced by all. Unfortunately I don't think these things are imminent.

Cynics may say that a generation is too short a time to change a business, technology and social paradigm. But is this true? The change from the small scale diggers in Kimberley to the Randlords took about a decade.

In modern times change happens just as quickly. Let me remind you that: Google is 18, Facebook is 13 and Twitter is 11 years old. Last month, the 14 year old Tesla overtook the market cap of the 113 year old Ford. Closer to home it took just 4 years and two months from the release of Nelson

Mandela from prison to his election as our first democratic president. The one set of examples digitised our world as we all are now orientated to the internet. The other democratised our country.

When we consider the lesson of other paradigm shifts such as the shift from medieval to modern science or artisanal to mass production – it is clear that it is not enough for a few dreamers, mavericks or innovators to come up with the answers. What is needed is for the range of anomalies or conflicts associated with the old ways to become so pervasive they can't be explained or contained by the current model anymore. This tends to induce a crisis in the business as usual model and ultimately makes EVERYONE change how they understand their world.

What's interesting is that facts, science and technology alone aren't enough – culture, leadership, politics and even capital allocation play a huge role.

In these politically tense times when the air is thick with rhetoric, and the streets full of marchers, some people are saying the mining industry needs to be broken and built up again from scratch. I certainly wouldn't go that far. What I am saying is that incremental change is no longer serving us well – if it ever did. We do know that major change is needed – and that it is possible.

Many of you will be familiar with the Chamber's *Mine 2030* initiative to drive industry modernisation. As part of Anglo American, at Kumba we are reaching for a whole new way of mining through what we call FutureSmart Mining™. FutureSmart Mining™ is not just about how we're innovating using technology in mining, but it is also about how we approach the full set of challenges facing any mining company - from safety, environment, social expectations in our host communities and in terms of our relationships with all tiers of government. In outline FutureSmart Mining™ envisages a mine that is automated and low-cost, concentrated and flexible, water-less, and integrated. To expand on these elements:

- The Modern Mine – employs automation and advanced drilling and cutting systems, without the need for explosive blasting.
- Concentrate the Mine™ - integrates a number of enabling technologies to extract more precisely the metal or mineral, with less waste.
- The water-less mine - as the name suggest, aspires to processing without the use of fresh water; picture a mine without a single tailings dam! And then what we call,
- The Intelligent mine – that uses advanced “big data” analytics and machine learning to reveal new patterns and trends, from mine to market and sensor to boardroom.

Let me now turn to iron ore. Our peers are also investing heavily in technology, for example:

- In Brazil, the automation of the heavy haul rail increased productivity and decreased costs.
- In Australia, a major producer allocated US\$8.1 billion for a truck-less system of conveyor belts that replaced over 100 trucks, and
- Some of our Australian peers introduced integrated remote operations centres significantly improving throughput and reducing costs.

We need to move fast in order to stay competitive. At Kumba we are embracing technology. In 2014 we developed a technology strategy to deliver on our business strategy of being a safe, long-term, low-cost producer of high-quality iron ore. Our technology roadmap ensures implementation of the best possible technologies throughout the mining value chain - from exploration to beneficiation. We believe that this is our future. Since 2014 we have spent in excess of R500 million on implementing this strategy.

We also want to utilise technology solutions to make the workplace safer for our employees. We have removed people from harmful environments, built advanced operations centres and implemented real time efficiency management solutions.

Crucially, rather than replacing employees, we have shown that implementing technology in our operations improves skills and provides an opportunity for staff development and growth. By enhancing working conditions, employees are excited and motivated about their work environment.

For example, one of our most successful projects has been the automation of the drilling fleet at Kolomela where we now have six drills, fully automated and operated from a remote command centre, located next to the offices. This has increased direct operating hours by 20% from 14 to 17 hours a day and allowed us to improve productivity and therefore the quality of our drill holes at a lower operating cost. We don't have to stop drilling to change drivers down in the mine – they simply swap seats in the control room at the end of their shift. Because we operate drills for longer we will need less of them over the life of mine – a huge saving.

Importantly, no jobs were lost. Drill operators embraced the change. Leigh Ann Booyesen, who has worked as a drill operator for four years, told us she never wants to go back to the old way of working and that she can now proudly boast to her family that she has an office job.

A second project that reinforces our focus on safety has been the co-development of autonomous braking for haul trucks with Komatsu and Hexagon Mining. Together with our technology partners, we have developed an active collision avoidance system to prevent imminent collision by means of

automatic speed adjustment and brake application. Kumba was the first open cast operator to successfully test this technology which will be rolled out to the rest of our fleet in the next two years. The majority of our trained operators agreed that the system adds an important layer of safety to our operations. We look forward to seeing auto-breaking technology have a positive impact on safety and production. In fact, this technology already complies with chapter 8 of the Mine Health and Safety Act - a standard the DMR expects all open cut mines to meet by June 2019.

Crucially our technology programme is also very much about upskilling our employees and the development of skills in our country. We believe in building a robust skills base in the country and want to ensure that the professionals of the future will have access to world class innovation and technology. Kumba sponsors a Virtual Reality Centre at the University of Pretoria's Mining Engineering Department which is now used to enhance education, training and research across industries. We continue to partner with Pretoria and other universities and research institutions to promote the use of technology in mining.

We are now able to re-process vast quantities of waste at Sishen mine thus releasing new reserves and actually increasing the life of mine. As the current slide shows over time we have utilised technology to unlock significant value in our business. We have already progressed our new ultra-high dense-medium separation (UHDMS) to a stage where we can declare an additional 210 million tonnes or so of mineral resource at Sishen. It is likely that, as our Sishen beneficiation projects continue to make progress, we will ultimately be able to unlock a significant resource potential of more than 1 billion tonnes.

We are also taking to the skies. Kumba now has 10 drones at Kolomela and Sishen which use scanners and cameras to create three-dimensional images of ore to calculate volume. They can be used to survey accident scenes and areas that are deemed to unsafe for workers to enter. You may not know this, but flying a drone requires high skills levels, so five of our staff trained as pilots and received their licences from the SA Civil Aviation Authority to use the technology.

There are many more such technological innovations within Kumba and Anglo American – such as progress we are making towards creating the waterless mine through water conservation and evaporation control.

However what I rather want to draw your attention to through this brief synopsis of some of our modernisation efforts is the many lessons that occur outside of technology. These are, in no particular order, that we need to work in partnership with OEMs and educational institutions; that

upskilling workers and achieving their buy-in is both possible and vital; that modernisation and technology can improve productivity, safety and extend the life of mine; and that this can get support from government, communities and investors alike.

So to answer our original question: Do we need a new paradigm for mining?

I would answer yes, but that throwing technology at the problem is not enough. To return to Henry Ford - bolting technology onto the business model doesn't revolutionise it – but simply tries to build a faster horse. If we do that we will only be perpetuating our current century old model and we won't take the country with us.

For us to thrive, I think we have no choice but to forge ahead modernising, investing and demonstrating that we are changing and redefining ourselves. But what we are saying is that innovation and technology are only part of the story. A true paradigm shift is something that changes the whole way we think about our world – from science to ethics, to investment, to politics, to social, government and labour relations. In short a completely different kind of mine. One that incorporates social, economic and environmental interests, within a self-sustaining mining “ecosystem”.

Rapid paradigm shifts are possible but they are not comfortable. If we are to create the mine of tomorrow – we must change our thinking today. And that means everyone – including us.