

THE FUTURE OF MINING FOR THE BETTERMENT OF INDUSTRY AND ENVIRONMENT

INTRODUCTION

Mining represents over half of national exports for at least 16 developing countries and is fuelling numerous emerging nations in the new global economy¹. However, it faces various new challenges. The rise of social media has left it exposed to public sentiment that does not always reflect the best mining has to offer. This delicate balancing act continues to shift and evolve as the industry moves into the digital age. Governments are also trying to regulate and offset the increasing need for raw materials in a world more susceptible to climate change and more in need of environmental protection than ever before.

Despite the huge amount of change that has transpired in other industries, mining itself has not fundamentally changed. Miners remain concerned with technologies that ultimately drive increased productivity while helping to ensure the people's safety on- and offsite. While these advances are by no means trivial, they have not changed traditional mining practices. Miners remain very conservative in their approach to investment and risk yet seem very secure thinking that disruption for such a capital-intensive industry must come from a larger source.

Off the back of this new perception, governments around the globe have been introducing legislation to minimise the ecological damage mining creates. In return, this has made mining more conservative.

To better understand the challenges the industry faces and the new technologies that could disrupt mining in Australia, SAP and PwC have teamed up with a group of industry influencers to explore the future of the resources sector.





ROUNDTABLE ATTENDEES



Anton Kroeger
Senior Director of Energy
& Natural Resources
SAP ANZ



Kristie Young
Director
Perth Clients, Markets & Resources
Business Development Lead
PwC Australia



Samir Damag
Solutions Manager,
IBU Mill Products & Mining
SAP SE



Claire Negus
General Manager, Commercial
Gindalbie Metals



Raleigh Finlayson
Managing Director
Saracen Mineral



Justin Strharsky
Director
Unearthed Solutions



Michael Lomman
General Manager of Demand Chain
Roy Hill



Brad Cuff
Partner, Analytics & Technology
PwC Australia



Jimmy Wilson
Chief Executive Officer
CBH



Adrian Griffin
Chief Executive Officer
Lithium Australia



Brett Smith
Business Development Executive
PwC Australia





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Miners can no longer afford to ignore the role they play in a much larger economic, social and technological ecosystem – an ecosystem that is growing and becoming more complex every day.

— PwC 2019 Whitepaper

BACKGROUND

To understand the dynamic changes the mining industry faces, SAP and PwC have joined forces to discuss the potential and existing challenges, technologies, disruptors, and opportunities that could shape the face of mining in the coming years.

Speakers and attendees were inspired to think about how the industry may change, whether it has the capacity to change for the better, and how to stay abreast of these potential changes. One clear takeaway from discussions was that the mining sector could no longer afford to keep the ingrained and conventional view it has of its sector and the environment in which it operates – mining must understand its role as an industry and global citizen.

As the 2017 PwC whitepaper on mining's future noted, "Miners can no longer afford to ignore the role they play in a much larger economic, social and technological ecosystem – an ecosystem that is growing and becoming more complex every day."²

A study conducted by the Queensland Government showed that despite mining's significance to the economies of Queensland and Western Australia, the investment by start-ups was a tiny fraction compared to other industries focused on end customers – such as social and retail services. Unearthed estimated that global investments into new start-up programs was over US\$200 million – of which, mining has only been able to attract a small fraction. The mining industry seems focused on sustaining technology investment and adapting with change rather than reshaping the sector in anticipation for change.

According to Ms Negus, one of the industry's key challenges is creating an environment that accepts failure as a step towards progression.

"The downside of trial and error in our industry is material, so we need to work out how we can take the fail-fast aspect of start-ups and put it into our context. From a people perspective, I think there's a lot of collaboration to be had around being willing to fail."

With mining as the cornerstone for various industries such as manufacturing, energy, and construction, the resources sector has an obligation beyond its own operations to create communities and innovate raw materials for the advancement of society and technology.

However, as Mr Finlayson noted, many mining operators are too timid and risk adverse to invest in new technologies and operational processes. "A lot of the underground businesses are run by smaller companies that don't really have the balance sheet to invest in things like automation," he explained.

It seems most miners would describe themselves as fast followers; they rely heavily on OEMs and service companies to provide the innovation required to improve efficiency. While this strategy has served miners well over the last few centuries, it is likely that disruption will not come from within the industry but rather from an external force shaping its own path in the digital economy. The group identified four primary focus areas that miners need to consider for remaining relevant in the future and embracing disruption for the betterment of the industry.



FOCUS 1:

PUBLIC PERCEPTION AND GAINING TRUST

Unfavourable public perception steals away from mining's licence to operate while making it more challenging to attract new talent to the industry.

It only takes a single disaster to shake up public opinion for months on end. Mining has been locked in an ongoing public-relations battle since it began. Mining treads a fine line between community development and threat to the environment. In this era of heightened awareness and environmental volatility, media often amplifies the negative effects of the industry while the positives go unseen or unreported. Recent global outcries against the industry's safety and environmental risks such as mine-site protests in Peru³, Guatemala⁴, Mexico⁵, the UK⁶, and even in the streets of Sydney⁷ are all examples of the uphill battle mining faces for public approval.

Protests, public opinion, and safety concerns have all led to mining companies removing key executives and suspending operations altogether.⁸ Social media has shifted the balance of power into the hands of the public as business entities and careers have been ruined with hashtags and activism. Since public outrage and opinion have profound influence on how companies operate, mining is starting to realise the importance of conveying its value and social responsibility to the world.

Mr Strharsky expressed how the industry is losing the war for perception and the subsequent effect this has on bringing new talent and ideas to the industry. He cited a competition hosted by a mining company with a million-dollar prize for the development of new algorithms to help discover new deposits. Mr Strharsky noted that some data scientists and experts refused to participate because they see mining as extractive, dirty, and harmful to the environment. "I think there are real issues that we as an industry have to be more willing to accept accountability for," he added.

Mining must be more transparent and attentive to public concern in order to elevate its image as a responsible and valued industry in this technologically and socially connected world.





FOCUS 2: CLOSER COLLABORATION BETWEEN MINING, EDUCATION, AND OEMS

While public perception plays a key role in attracting and retaining talent to mining, there are also clear gaps between industry and education. The need to better align with educational institutes would not only create a better-skilled workforce for the future but increase the potential for significant industry innovation.

Mr Finlayson affirmed this issue, stating, “One thing we generally do quite poorly as an industry is training and advising the institutions – whether they be TAFEs, universities, or schools – about what we need for the future. If you take a mining engineer curriculum when Curtin [University] took over WAIT [Western Australian Institute of Technology] 50 years ago compared to now, it’s exactly the same curriculum bar one unit.”

However, in April 2019 Curtin University announced it would be adapting its WA School of Mines: Minerals, Energy and Chemical Engineering curriculum in response to emerging industry changes such as robotics, data analytics, and additive manufacturing (3D printing). “The development follows a cross-university working group initiated by Curtin, in consultation with the relevant stakeholders including high-profile alumni, to develop an action plan that stimulates demand for courses relating to the resources and mining sectors and helps build a pipeline of skilled employees.”⁹

While there has been incremental change regarding mining’s relationship with education, the industry has also struggled at engaging across its supply chain to create more holistic and synthesised solutions. “What if Caterpillar offered all the data that comes off their equipment, an API

(application programming interface), a software development kit to developers around the world in exchange for 20 per cent of the revenue of any application that is generated on that platform?” Mr Strharsky asked. “What would the pace of innovation and automation on Caterpillar equipment be like compared to how it is now and compared other OEMs?”

Miners need to engage outside their own organisations and ecosystems, tap into other think tanks with the capacity to improve current mining practices and potentially reshape them. Mr Strharsky referenced Joy’s Law (named after Bill Joy, founder of Sun Microsystems) as the key principal to how we should think; ‘no matter who you are, most of the smartest people work for someone else’. In a digitally connected world, the ability to reach this extended talent pool could be a hallmark for success.

Looking at the battle between Apple and Android – both these platforms provide a wealth of content through its apps, yet most of these innovations were not developed by Apple or Android, but rather independent companies leveraging the reach of these established operating systems. This shows how newcomers can elevate established operators with their fresh thinking and creativity.

FOCUS 3:

INDUSTRY DISRUPTION THROUGH AUTOMATION

With the implementation of driverless trucks and trains, mining has been a pioneer in automated technology – however, most of this intelligent technology has been developed in partnership with OEMs.

With automation and electrification impacting on numerous industry sectors, OEMs and mining operators have the chance to adopt these new technologies and streamline the supply chain from end to end, taking advantage of innovations that are happening at scale outside and inside the industry. Autonomous technology provides mining with the opportunity to embrace change and stay ahead of industry trends, while the mining sector offers new innovators an environment that is well regulated and less populated to test and refine their technological advancements.

Mr Wilson said, “Autonomous trucks totally change the way we operate our business because all of a sudden you can drive further because there are no people involved and it will cost less – but there are other things that you could push that are far more value increasing.”

Automation not only minimises the risk and cost of operating but can completely reshape the way mining organisations allocate staff. Mr Griffin said, “Going back nearly 30 years, I went to a base-metals mine in Kiruna, Sweden, which was pulling out two million tonnes a year with only four people underground. When I asked the mining manager why they were doing this, he said it was all about the cost of labour.

“He explained, ‘In Sweden you cannot afford to have people underground; I started at this

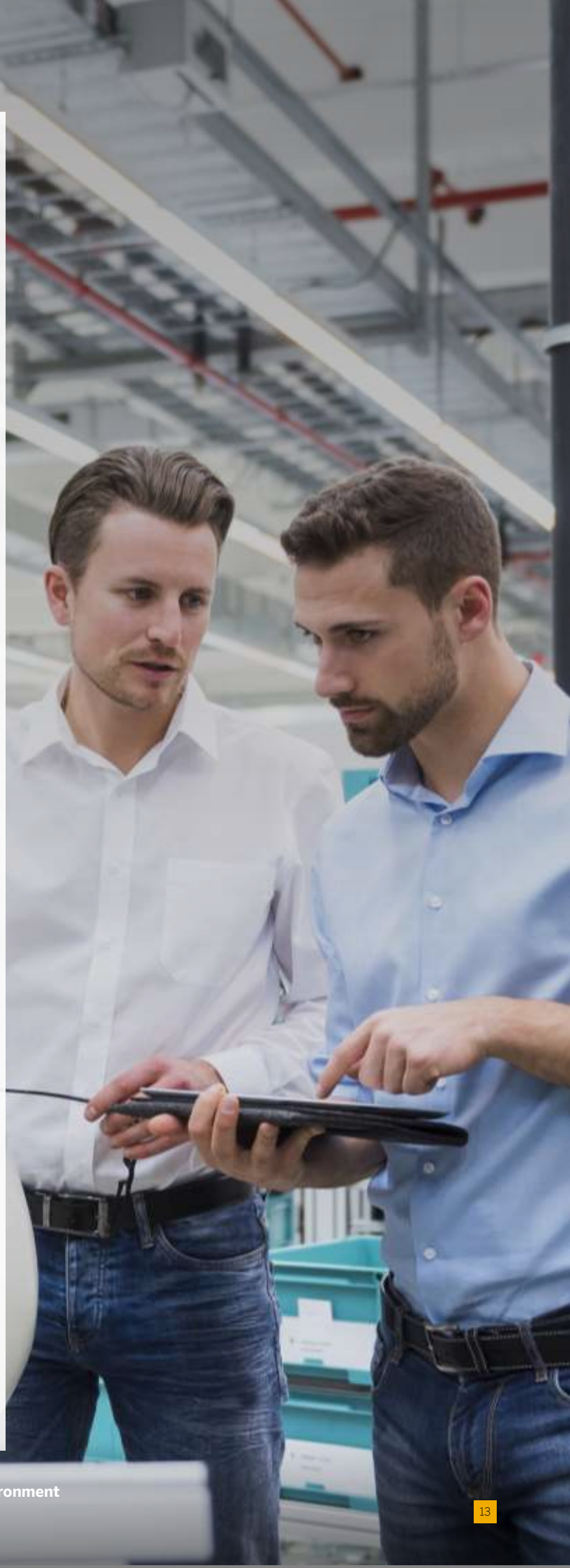
operation three years ago and I had a personal assistant, but the labour laws here say that if she takes maternity leave, I’ve got to supply six months half time, 12 months full time, and I’ve got to leave the job open for when she comes back to work’.”

Mr Griffin noted how these strict HR regulations forced Swedish companies to restructure its operations and led to innovation with Sandvik’s OptiMine and AutoMine technologies creating the backbone for the world’s first fully automated mine¹⁰.

These technological developments aren’t about taking away jobs; the focus is to make mining safer and more efficient while creating new roles and skills for people to prosper in this changing industry landscape. By upskilling the local community and reducing the need for expensive, foreign workers, automated mining is reducing its environmental impact while empowering local workers with future-ready knowledge and experience.

By changing the way miners operate, automation can greatly reduce the risk and dangers of mining. It also has the potential to empower and scale some sectors of mining like artisanal and small-scale mining (ASM). ASM is a vital socioeconomic contributor to developing nations is seeing continuous growth. “An estimated 40.5 million people were directly engaged in ASM in 2017, up from 30 million in 2014, 13 million in 1999 and 6 million in 1993. That compares with only 7 million people working in industrial mining in 2013.”¹¹ However, this subsector has seen overlapping and ambiguous jurisdiction between different levels of government along with regulatory and political ambivalence. This lack of oversight has made ASM unsafe and underregulated because of its very nature.

Automation and miniaturisation brought together by digitalisation and electrification has the potential to transform ASM mining. Miniaturising equipment brings down the entry barrier, making it far easier for small-scale miners to utilise safe and efficient machinery. Using small-scale operations, the industry can benefit from the agility of ASM to unlock difficult and currently uneconomic reserves. ASM has the potential to set in motion the “Uberisation” of the mining industry as it quickly shifts the balance of power away from the large regulated companies to smaller, nimbler, and socially regulated ASM companies.



FOCUS 4:

THE PROMISE OF A CIRCULAR ECONOMY

In this world of social connectedness and environmental consciousness, people and governments are collectively pushing for a reduction in waste and emissions.

The cost of mining copper continues going up because mines are deeper and the commodity is becoming scarcer across the planet, so there's a tipping point where economically it will be better to recycle," Mr Lomman explained. "There's debate as to whether the cultural side of recycling will come first or social licence."

Mr Griffin offered an example of how government legislation combined with public pressure is driving innovation and making mining safer for people and the environment. "If you look at what's happening in China – it's actually driving revolutionary change in the delivery of energy and a lot of other aspects. They are doing the right thing there, incidentally and environmentally, where they have realised the cost of the damage mining's done to the environment is greater than the amount of metal that you get out."

A study of China's recycling economy highlighted the numerous green industrial chains within the country's mining-waste treatment – such as "gangue piles turned into man-made eco-park, gangue used for power generation, fly-ash used in building material, coal mining water reused and recycled in closed pipelines, CBM extracted for home-burning and electricity generation".¹² The Chinese government demonstrated how legislation can help create national change in mindset and push the development of a circular economy.

Building a circular economy needs to be a global objective if it's ever going to be realised. Mr Griffin explained, "The reason we mine is because we've got population growth and we don't recycle."

According to Mr Griffin, 90 per cent of batteries worldwide end up in landfill. "The globe is saying we have a cobalt shortage, but we're mining these things, processing them, and then throwing them into landfill," he said. "We're creating new ore bodies in the landfill environment. Recycling will become, without a shadow of a doubt, a critical issue for the longevity of the human race – not just the mining industry."

Mr Wilson said pushing miners towards waste reclamation will increase operating costs while reducing waste and land disposal. "Forcing waste reclamation will also go towards creating a more responsible economy," he added. "In this instance, traditional miners will see an increased importance in the quality of resources as circular economy puts the focus on recycling."

Mr Damag noted that the circular economy must encompass all stakeholders within the supply chain since the onus cannot strictly be on the mining sector. "Part of the circular economy is to design new products so the minerals can easily be dismantled and extracted in a way that means you don't need to have cumbersome processes," he explained.



Technology pioneers Apple is already contributing to the notion of circular economy through the development of its disassembly robot – Daisy. This automated machine can dismantle nine different kinds of iPhones at a rate of 200 per hour to extract and separate rare earth magnets, alloys, tantalum capacitors, titanium screws, aluminium, semiconductors, bonded glass, and displays for recycling.¹³

The emergence of the share-economy is also playing a key role in how technology shapes service delivery and resource usage. “Uber, the world’s largest taxi company, owns no vehicles... Airbnb, the world’s largest accommodation provider, owns no real estate.”¹⁴ Following this logic and the swift change across industries seen through these disruptors, the mining industry of the future may not own any assets, but rather the recycling technology that makes a circular economy possible.

Consumer demands are helping to define regulation – particularly with regards to environmental responsibility – the roundtable found. Ms Young said, “A circular economy is plausible because the public will demand it. As we end up with more waste and less resources, we probably won’t have a choice, but to work towards it. There could also be disruption to the political landscape and that could change further as the public demands more from politicians.”



CONCLUSION

The rapid rate of technological development is disrupting most industries. The mining industry today has not yet experienced full-scale disruption as it's shielded by the high cost of capital and risk aversion. Instead, the mining industry is focused on incremental improvement towards operational efficiency and environmentally conscious practices. This is being driven by legislative change, shifting public sentiment, and increasing pressure on commodity prices.

The finite nature of natural resources means that it is only a matter of time before the scales tip from extraction to recycling. Technology will play an important role in facilitating this transformation towards sustainability, but industry must prepare for change now if it's going to be ready for the future of mining.

If mining companies are to survive in the future world, they need to become a lot more aware of the subtle changes in public perception and how this traditional industry is shaping up against newer, less conventional players. Bridging the gap between organisations and innovators, thinking beyond the technical limitations and practices of today, and being aware of how the circular economy is re-shaping the world will all be critical for the survival and prosperity of the mining sector.

The face of mining is changing rapidly, and it doesn't have the luxury of waiting to see how disruptors will create change – mining must drive change from within and outside the sector. Technology will continue playing a vital role in causing industrywide disruptions, so the entire mining supply chain needs to work towards developing and facilitating these technological changes.

The promise of nirvana via automation should not be limited to hardware and machinery, as it has the potential to create end-to-end efficiency across the mining industry and supply chain. Technology is not the end solution to reshaping the industry, but it will facilitate the change necessary for modernising the mining sector. Restructuring the industry for a circular economy

requires new ways of thinking and the technology to support these innovative procedures.

Other industries are realising the time, resources, and risk that can be minimised through intelligent technologies such as data-analysis, machine learning, and automation. For more information on how you can transform your organisation into an intelligent enterprise, please contact Anton Kröger (anton.kroger@sap.com) or Brad Cuff (brad.cuff@pwc.com).

RESOURCES

Outlined below is external research that was used as supporting material for this paper.

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ABOUT THE AUTHORS



Anton Kroeger

Senior Director of Energy
& Natural Resources
SAP ANZ

Anton Kröger is an experienced industry thought leader with experience in mining, oil, and gas. He is passionate about helping resource companies innovate and transform their business through digital transformation.



Brad Cuff

Partner, Analytics & Technology
PwC Australia

Brad Cuff's background pairs analytics and operational technology with mining, agriculture, banking, and wine industries. He is passionate about people and cares deeply about helping clients deliver optimal business outcomes in the digital age.



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