A REVIEW OF WESTERN AUSTRALIAN COMPANIES LISTED ON THE AUSTRALIAN SECURITIES EXCHANGE

DELOITTE WESTERN AUSTRALIAN INDEX DIGGERS & DEALERS SPECIAL EDITION

2016

Deloitte
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Executive summary

This year’s Diggers & Dealers special edition highlights the key movements occurring during the financial year ended 30 June 2016. During the year the Deloitte WA Index rose 1.8%, closing at AU$134.5bn.

Among the major mining index players:

- **Northern Star Resources Limited**’s market capitalisation increased by AU$1.6bn (126.3%) during the year, driven largely by an increase in gold prices, a depreciating Australian dollar and the ability to drive low cost production growth.
- **Fortescue Metals Group Limited**’s market capitalisation increased by AU$4.9bn (83.2%) during the year due to aggressive cost reduction strategies combined with its efforts to repay debt.
- **Regis Resources Limited** and **Saracen Mineral Holdings Limited**’s market capitalisation increased by AU$1.2bn (216.7%) and AU$812m (238.3%) respectively during the year due to the increasing gold prices and favorable exchange rate movements driving improved margins.

Despite being another volatile year for global commodity markets, with many of the commodities surveyed being hit with further price decreases, the safe haven assets of gold and silver offered much needed upside opportunities for Australian investor portfolios.

**Gold and silver** were the stand out performers showing a substantial price increase of 13.0% and 18.0% during the year and even higher on an Australian dollar basis, with the uncertainty in the commodities market and the Brexit evidently working to their advantage as investors took refuge in the safe haven commodities.

The gold price has also benefited from global institutions increasing their allocation of gold within their portfolios during the year.

Crude oil fluctuated throughout the year, with a partial recovery from a low of below US$30/bbl in January 2016, finishing the year at US$49.98/bbl, an overall drop of 17.0% from June 2015. The commodity rebounded as supply relief was sparked by decreases in American production and wildfires impacting oil sands exports in Canada. Iron ore reached its lowest point at US$38/tonne in December 2015 as demand slowed from China. It has now stabilised at US$54.50/tonne, with continued supply growth from major suppliers expecting to restrict further price increases in the short term.

Despite a stronger last quarter, nickel’s performance was poor for the year, dropping by more than 21.2% since June 2015, however the commodity’s recent performance is certainly positive.

It was a disappointing year for global indices with small gains only experienced by the US S&P 500 (1.7%). The FTSE 100 and All Ordinaries suffered slight decreases of 2.5% and 2.6% respectively, whilst the Nikkei dropped by a staggering 23.0%. Weak international demand and the aftermath of the Kumamoto earthquake caused a slowdown in Japan’s manufacturing Industry, which has driven the decrease.
Deloitte WA Index highlights
In this special edition of the Deloitte WA Index we highlight a number of emerging issues and areas:

• Lithium: Fact or fiction: Is the lithium story all hype or do the fundamentals support it being a commodity that will, after the dust settles, continue to attract ongoing investment and development?

• Where to from here: Innovation in Mining: This article focuses on the importance of using the right methods, tools and approaches at the right times, in order to evolve, adapt and improve operations

• Advanced Manufacturing: A harbinger for the mining sector: This article discusses how lessons from advanced manufacturing can help drive operational efficiencies in mining

• Creating sustainable cost savings: This article discusses how data analytics is one of the leading edge tools to inform businesses of process improvements that can identify and drive sustainable cost savings.

Deloitte WA Index high growth awards 2016
Among the commodity chaos there are gems to be found, particularly those companies that have lithium and/or gold assets. At the Diggers & Dealers conference on 1-3 August 2016, we will recognise the top three movers in the WA Index top 20, in terms of market capitalisation growth, for the year ended 30 June 2016. These are:

• Galaxy Resources Limited: Increased its market capitalisation by 1,555% from AU$40m to AU$662m

• Pilbara Minerals Limited: Increased its market capitalisation by 923% from AU$69m to AU$706m

• Resolute Mining Limited: Increased its market capitalisation by 330% from AU$196m to AU$843m.

We will also recognise the largest three movers of the WA Index top 100, in terms of market capitalisation growth, for the year ended 30 June 2016. These are:

• General Mining Corporation Limited: Increased its market capitalisation by 3,514% from AU$7m to AU$253m

• Capricorn Metals Limited: Increased its market capitalisation by 2,333% from AU$3m to AU$73m

• Millennium Minerals Limited: Increased its market capitalisation by 2,180% from AU$5m to AU$114.
Despite it being another challenging year for many of the commodities that are important to the WA economy, it is pleasing to profile a number of companies that have significantly outperformed their WA peers. Making the most of a year that favoured safe-haven investments as well as the excitement surrounding fundamental advancements in lifestyle and energy-related technology, it is not all doom and gloom this year for the resources sector.

The volatile markets during 2016, amplified by the recent Brexit announcement, saw significant fluctuation in the Australian-dollar gold price. This pushed investors to further build exposure to Australian-based gold producers to take advantage of strong margins. Therefore, the relative outperformance of Australian based gold producers, who dominated our 2015 publication and again featured strongly in our top movers for 2016 will be no surprise to investors.

These companies were joined by those enjoying exposure to much sought-after lithium-based products. Continued demand for smartphones and lifestyle technologies, including lithium batteries and its application in the motor vehicle industry, boosted lithium prices by an exceptional 216.8% during the last 12 months, taking many lithium-exposed companies along for the ride.

### The largest three movers
(% increase in market capitalisation) in the top 20 companies by market capitalisation for the 12 months ended 30 June 2016 were:

<table>
<thead>
<tr>
<th>WA Index ranking</th>
<th>Resource</th>
<th>ASX</th>
<th>NAME</th>
<th>MKT CAP (AUS$M) 30 JUN 16</th>
<th>MKT CAP (AUS$M) 30 JUN 15</th>
<th>CHANGE IN YEAR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Lithium</td>
<td>GXY</td>
<td>Galaxy Resources Limited</td>
<td>662</td>
<td>40</td>
<td>1,555%</td>
</tr>
<tr>
<td>17</td>
<td>Lithium</td>
<td>PLS</td>
<td>Pilbara Minerals Limited</td>
<td>706</td>
<td>69</td>
<td>923%</td>
</tr>
<tr>
<td>15</td>
<td>Gold</td>
<td>RSG</td>
<td>Resolute Mining Limited</td>
<td>843</td>
<td>196</td>
<td>330%</td>
</tr>
</tbody>
</table>

Source: Capital IQ and ASX

### The largest three movers
(% increase in market capitalisation) in the top 100 companies by market capitalisation for the 12 months ended 30 June 2016 were:

<table>
<thead>
<tr>
<th>WA Index ranking</th>
<th>Resource</th>
<th>ASX</th>
<th>NAME</th>
<th>MKT CAP (AUS$M) 30 JUN 16</th>
<th>MKT CAP (AUS$M) 30 JUN 15</th>
<th>CHANGE IN YEAR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Lithium</td>
<td>GMM</td>
<td>General Mining Corporation Limited</td>
<td>253</td>
<td>7</td>
<td>3,514%</td>
</tr>
<tr>
<td>100</td>
<td>Gold</td>
<td>CMM</td>
<td>Capricorn Metals Limited</td>
<td>73</td>
<td>3</td>
<td>2,333%</td>
</tr>
<tr>
<td>72</td>
<td>Gold</td>
<td>MOY</td>
<td>Millennium Minerals Limited</td>
<td>114</td>
<td>5</td>
<td>2,180%</td>
</tr>
</tbody>
</table>

Source: Capital IQ and ASX
Galaxy Resources Limited increased its market capitalisation by 1,555%, from AU$40m to AU$662m during the year ended 30 June 2016, and was ranked 20th in the Deloitte WA Index and the top mover in the top 20 by market capitalisation.

**Background**
Galaxy Resources Limited (Galaxy) is a global mining, exploration and processing company with multiple lithium assets spanning Australia, China, Canada and Argentina.

**Operational overview**
It comes as no surprise that Galaxy was awarded one of the top movers during the year given the positive movement in lithium prices. Galaxy owns the Mt Cattlin spodumene-tantalite mine located in Ravensthorpe, Western Australia, which was back on investor radars following the partnership agreement with General Mining Corporation in September 2015 to invest in the project with a focus on recommencing operations. Production recommenced in March 2016.

During the year, the company also managed to secure sale and distribution agreements with off-take partners for concentrates produced. This marked a major milestone, being the recognition of the Mt Cattlin project as a high quality source of lithium supply to the global market. Production restart and the first concentrate delivery, which is expected in September 2016, have significantly boosted investors’ confidence in the viability of this project.

On top of the flagship Mt Cattlin project, Galaxy owns the Sal de Vida lithium and potash brine project in Argentina, located in the ‘lithium triangle’, where Chile, Argentina and Bolivia meet, which accounts for approximately 60% of global lithium production. Galaxy also has the James Bay lithium pegmatite project in Quebec, Canada. It is anticipated that the James Bay project will be an opportunity to capitalise on long-term lithium growth in the Northern American markets due to its comparably low energy costs and access to infrastructure.

**Going forward**
During the past year, Galaxy has focused on the restart of production at the Mt Cattlin project, in which it held an 86% interest in as at 30 June 2016. Galaxy’s commitment to this project has recently been reiterated via its takeover offer for General Mining Corporation (General Mining), in which it stated to shareholders that the resulting merged company would have a market capitalisation of approximately A$700m and would be one of the ASX’s largest lithium exposed stocks.
Pilbara Minerals Limited increased its market capitalisation by 923% from AU$69m to AU$706m during the year ended 30 June 2016, and was ranked 17th in the Deloitte WA Index and the second largest mover in the top 20 by market capitalisation.

Background
Pilbara Minerals Limited (Pilbara Minerals) is a lithium and tantalum mining and exploration company operating in the Pilbara region of Western Australia.

Operational overview
Pilbara Minerals’ portfolio of projects comprises two near-production assets located within 100km of Port Hedland, where significant milestone events have occurred during the year across both projects to take advantage of strong market conditions and rapidly increasing demand for lithium.

The 100% owned Pilgangoora lithium -tantalum project contains a world-class resource and is being aggressively explored by the company. The Pilgangoora project has been confirmed as the largest new lithium ore (spodumene) deposit in the world and is set to be developed into one of the world’s largest lithium mines producing tantalite as a byproduct.

In September 2015, Pilbara Minerals entered into lithium off-take memorandum of understandings (MOUs) with an undisclosed multi-national North American company and Mitsubishi Corporation for the future supply of spodumene concentrate commencing in 2017, indicating a strong level of interest and demand from potential customers and off-take partners in the Pilgangoora project.

Ongoing feasibility studies on the Pilgangoora project have been carried out with the resource in-fill and extensional drilling programs completed throughout the year delivering a host of positive results on multiple fronts, paving the way for future resource upgrades. In April 2016, Pilbara Minerals successfully raised AU$100m via placement of shares at an issue price of AU$0.38 per share, demonstrating significant institutional demand supporting the company towards production. The strong rally in the share price during the year has also been driven by the lithium price rally as demand for electric vehicles increases.

Another of Pilbara Minerals’ projects, the Tabba Tabba Tantalum project (Tabba Tabba), contains a relatively small but exceptionally high-grade tantalum resource, a key input into capacitors and smart-phone related technologies. However, in December 2015, this project was suspended pending further expenditure to modify the existing processing plant before the commissioning process could be finalised. This combined with the current tantalum market conditions means that the site will be suspended until market conditions improve.

Going forward
On 4 July 2016, Pilbara Minerals announced the signing of a binding off-take and downstream processing agreement with a leading Chinese producer of lithium carbonate and lithium hydroxide monohydrate, and a key supplier of lithium products and materials to the fast-growing lithium-battery industry in China. This has been tagged a landmark six-year agreement and will secure the sale of 140,000tpa of spodumene concentrate from Q1 2018, which represents more than 40% of Pilgangoora’s anticipated initial annual output of approximately 330,000tpa of concentrate from its phase 1 project.

A binding equity subscription agreement has also been executed with the off-taker agreeing to inject AU$17.8m in Pilbara Minerals and a further binding MOU has been executed with the formation of a 50-50 joint venture, positioning Pilbara Minerals to move up the lithium value chain.
Resolute Mining Limited increased its market capitalisation by 330% from AU$196m to AU$843m during the year ended 30 June 2016, and was ranked 15th in the Deloitte WA Index and the third largest mover in the top 20 by market capitalisation.

Background
Resolute Mining Limited (Resolute) is a gold mining and exploration company with operations in Australia and Africa with more than 25 years of experience in operating within the gold industry.

Operational overview
Resolute has undergone major transformation in the current year to maximise its exposure to the prevailing strong Australian dollar gold price with a refreshed organisational model and business strategy, strengthening its financial health, returning to profitability and shifting from a net debt to net cash position. This has allowed Resolute to focus on the company’s key organic growth projects at Syama, Ravenswood, and Bibiani.

The 80% owned Syama mine located in the south of Mali, West Africa has a robust and long mine life of beyond 2028, with an estimated production capability of approximately 250,000oz/pa. The current primary development focus is to transition to a large-scale underground mining operation at Syama. On 30 June 2016, the underground definitive feasibility study was completed and substantial upside was discovered with opportunities to extend mine life, increase mining recovery and reduce all-in-sustaining costs. This fed enthusiasm into the market about the long-term competitiveness of the Syama mine.

The 100% owned Ravenswood gold mine is situated approximately 95km southwest of Townsville in northeast Queensland. Ore for the Ravenswood operations is sourced primarily from the Mt Wright underground mine using the sub-level shrinkage with continuous fill mining method. Development of an additional level of the Mt Wright mine is underway, with the expected life of mine extended to October 2017. Resolute is also evaluating extending a number of adjacent open pits including the significant Sarsfield pit as part of a renewed focus on mine life extension at Ravenswood to optimise Resolute’s position under the prevailing gold price.

In Ghana, a positive feasibility study at the 90% owned Bibiani mine derived an expected mine life of five years with an estimated production capability of 100,000oz/pa across the mine life. The study was completed in June 2016 and confirmed Bibiani as a viable development pathway with excellent upside potential and relatively short development period of just nine months for all refurbishment and development activities. The completion of this feasibility study, which establishes the first ore reserve at the project, is an important milestone in the progress of this project.

Going forward
Resolute’s vision is to continue to focus on reducing operating costs as investments are made to extend mine lives at Syama, Ravenswood, and Bibiani.

Major technical improvements at Syama continue to strengthen the mine’s strong cash generation, and planning for the shift to an underground mine continues to produce encouraging results, with first development ore is expected later this year.

Extending Ravenswood’s operating life is also a priority with ongoing development and open pit mining expected to recommence at the Nolans East open pit in July 2016. This commencement will be an important first step in the anticipated redevelopment of a long life large-scale open pit mining operation at Ravenswood.

In the current environment of strong gold prices, Resolute remains focused on enhancing and exploiting its attractive growth opportunities.
General Mining Corporation Limited increased its market capitalisation by 3,514% from AU$7m to AU$253m during the year ended 30 June 2016, and was ranked 41st in the Deloitte WA Index and the top mover in the top 100 by market capitalisation.

Background
General Mining Corporation Limited (General Mining) is an explorer and miner established in 2007 based in Western Australia. Its strategy is to focus on high-grade projects with substantial exploration upside.

Operational overview
The company has a strong portfolio of projects with exposure to both lithium and gold exploration, which are in various stages of advancement.

Given the tightening supply conditions imposed on lithium carbonate refiners in mainland China as well as the significant increase in demand with increasing sales of electric vehicles worldwide, General Mining has capitalised on its early mover advantage, entering into a long-term partnership with Galaxy Resources Limited (Galaxy) to restart operations at the Mt Cattlin mine after more than two years on care and maintenance. This partnership was structured such that General Mining earned a 50% deemed operating profit interest in the Mt Cattlin project at Ravensthorpe, WA for a total consideration of AU$25m. General Mining could also earn a 50% equity interest in the 100%-owned Galaxy’s James Bay project in Quebec, Canada by spending US$5m over three years, including 50% in the first two years after signing the agreement.

Following the Mt Cattlin agreement, ongoing works such as refurbishment and resource extension drillings were carried out to progress rapidly towards the production restart, which was achieved in March 2016.

General Mining also owns three gold projects in Mercury Hill, Chesterfield and Mt Success. There has been little activity on these projects during the year as bringing the Mt Cattlin project into production has been a priority.

In May 2016, General Mining was approached by its Mt Cattlin partner, Galaxy, with a takeover proposal where General Mining shareholders will receive 1.65 new Galaxy shares for every 1 General Mining share held. This is expected to see the creation of a wholly owned portfolio of hard rock and brine based lithium assets across multiple jurisdictions and a more simplified single ownership structure and operational management at both the Mt Cattlin and James Bay projects.

Going forward
The takeover offer by Galaxy is expected to close in the third quarter of 2016. If the takeover is successful, it is anticipated that the combined group will emerge as one of the local bourse’s largest lithium players and a market capitalisation of more than AU$700m and a pipeline of assets in some of the more important lithium raw material regions in the world.
This involves accelerating the development of Karlawinda deposit including fast-tracking resource/reserve definition drilling and testing a number of newly identified gold targets at close proximity to the existing resource.

Going forward

On 4 July 2016, Capricorn announced that it had completed an updated inferred mineral resource estimate for the Bibra open pit gold deposit, which confirmed a 40% increase over the previously published inferred resource estimate for Bibra. This reflects the success of the company’s maiden drill program at Karlawinda and will form the foundation of ongoing scoping study activities, en route to a definitive feasibility study (DFS) planned to commence during 2016. A major new program of resource in-fill and extensional drilling at Karlawinda is also on the agenda and is expected to commence in July 2016, with exploration drilling to test numerous near-mine targets.

The Karlawinda project will be the sole focus of Capricorn to leverage strong Australian gold price, with assets previously held in Madagascar earmarked for divestment. The Karlawinda project remains largely unexplored with regional exploration still at an early stage.

**Capricorn Metals Limited** increased its market capitalisation by 2,333%, from AU$3m to AU$73m during the year ended 30 June 2016, and was ranked 100th in the Deloitte WA Index and the second largest mover in the top 100 by market capitalisation.

**Background**

Capricorn Metals Limited (Capricorn) is an emerging gold explorer and producer based in Western Australia. It was re-named from Malagasy Minerals Ltd in February 2016 on the acquisition of the Karlawinda Gold project, approximately 65km southeast from Newman in Western Australia.

**Operational overview**

Over the past year, Capricorn’s market capitalisation has enjoyed significant growth as a result of investors flooding into safe haven assets to brace against market instability. For Capricorn in particular, this was further fuelled by the purchase of its flagship Karlawinda project in February 2016, which is regarded as an extremely attractive near-term production and cash-flow opportunity for shareholders. The Karlawinda project, encompassing the Bibra Gold Deposit and Francopan Gold Prospect in the Pilbara region, is considered to have excellent regional gold potential that will significantly add to its resource base in the near term.

Capricorn has embarked on a strategy to become a low-cost open pit Australian gold producer. Key steps in this journey include a strongly supported share placement during the year, with funds allocated to advancing the Karlawinda Project to the next stage. This involves accelerating the development of Karlawinda deposit including fast-tracking resource/reserve definition drilling and testing a number of newly identified gold targets at close proximity to the existing resource.
Millennium Minerals Limited increased its market capitalisation by 2,180% from AU$5m to AU$114m during the year ended 30 June 2016, and was ranked 72nd in the Deloitte WA Index and the third largest mover in the top 100 by market capitalisation.

**Background**

Millennium Minerals Limited (Millennium) is a gold explorer and producer with a large tenement portfolio in the east Pilbara region of Western Australia.

**Operational overview**

As a growing gold explorer and producer, Millennium has enjoyed a series of positive events during the year, backed by the solid upswing in gold prices. It is an extremely attractive asset for investors as the flagship project owned by Millennium, the Nullagine project, delivers profitable results and stable production.

A significant operational and financial turnaround was completed over the past 12 months via implementation of an extensive business improvement program targeting enhanced productivity and optimised processes. These exercises were taken by Millennium to position it to benefit from strong gold prices with no debt, strong free-cash flow and a clear vision of growth.

Millennium’s flagship Nullagine project comprises multiple deposits. The largest deposit, Golden Eagle, is located approximately 10 km south of the Nullagine township. A $10m exploration program is currently underway to grow mine life and positive initial results were returned, supporting Millennium’s strategy to extend mine life at the Nullagine project with potential for gold inventory increases.

Drilling studies have also confirmed a significant new high-grade discovery at Anne de Vidia, 9km from the Nullagine Gold project’s processing plant.

During the quarter to 30 June 2016, the company signed a binding tenement sale agreement to acquire a 100% interest in 12 tenements situated within the Nullagine Gold project. These tenements were previously subject to a mining licence and profit share agreement whereby 25% of net proceeds were payable to the vendors. The acquisition simplifies the ownership structure of the Nullagine project by the company.

**Going forward**

Millennium’s vision is to build a significant mid-tier ASX listed gold producer focused on low cost, favourable margins and to leverage off the strong free cash flows being generated at Nullagine.

The Nullagine project has a positive outlook and is forecast to generate free cash flow to underpin Millennium’s growth strategy.

On 4 July 2016, Millennium announced that it has embarked on the first targeted deep-drilling program at Nullagine, in line with the next phase of its strategy to grow mine life. This drilling data is expected to be used to support a preliminary scoping study to modify the Nullagine processing plant to process fresh ore material.
Commodities and precious metals

Despite being another volatile year for global commodity markets, with many of the commodities surveyed being hit with further price decreases, the safe haven assets of gold and silver offered much needed upside for Australian investor portfolios.

Interestingly, lithium was the surprise package for 2016, with an increase of more than 200% as excitement builds over the potential for lithium batteries within electric vehicles and general power storage devices.

Despite the continued poor performance of some of the commodities, in comparison to the previous year where 13 out of the 14 commodities surveyed were heavily in the red, it was an overall better result.

Much of the volatility stemmed from excess supply, an uncertain global economy and decreased demand from China and emerging economies. To close out the financial year, the Brexit shock further impacted global commodity markets. Gold and silver investors were, however, grinning from ear to ear.

<table>
<thead>
<tr>
<th>Name</th>
<th>Metric</th>
<th>30 June 2016</th>
<th>30 June 2015</th>
<th>Mvt ($)</th>
<th>Mvt (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>US$/troy oz</td>
<td>$1,321.07</td>
<td>$1,169.35</td>
<td>$151.72</td>
<td>13.0%</td>
</tr>
<tr>
<td>Silver</td>
<td>US$/troy oz</td>
<td>$1,855.00</td>
<td>$1,571.50</td>
<td>$283.50</td>
<td>18.0%</td>
</tr>
<tr>
<td>Platinum</td>
<td>US$/troy oz</td>
<td>$1,009.40</td>
<td>$1,078.00</td>
<td>-$68.60</td>
<td>-6.4%</td>
</tr>
<tr>
<td>Palladium</td>
<td>US$/troy oz</td>
<td>$589.00</td>
<td>$677.00</td>
<td>-$88.00</td>
<td>-13.0%</td>
</tr>
<tr>
<td>Copper</td>
<td>US$/tonne</td>
<td>$4,840.00</td>
<td>$5,754.75</td>
<td>-$914.75</td>
<td>-15.9%</td>
</tr>
<tr>
<td>Nickel</td>
<td>US$/tonne</td>
<td>$9,401.00</td>
<td>$11,932.50</td>
<td>-$2,531.50</td>
<td>-21.2%</td>
</tr>
<tr>
<td>Aluminium</td>
<td>US$/tonne</td>
<td>$1,643.00</td>
<td>$1,651.00</td>
<td>-$8.00</td>
<td>-0.5%</td>
</tr>
<tr>
<td>Lead</td>
<td>US$/tonne</td>
<td>$1,785.25</td>
<td>$1,743.75</td>
<td>$41.50</td>
<td>2.4%</td>
</tr>
<tr>
<td>Zinc</td>
<td>US$/tonne</td>
<td>$2,102.00</td>
<td>$1,995.75</td>
<td>$106.25</td>
<td>5.3%</td>
</tr>
<tr>
<td>Tin</td>
<td>US$/tonne</td>
<td>$17,075.00</td>
<td>$13,908.00</td>
<td>$3,167.00</td>
<td>22.8%</td>
</tr>
<tr>
<td>Crude Oil (Brent)</td>
<td>US$/bbl</td>
<td>$49.98</td>
<td>$60.22</td>
<td>-$10.24</td>
<td>-17.0%</td>
</tr>
<tr>
<td>Uranium</td>
<td>US$/lb</td>
<td>$27.00</td>
<td>$36.50</td>
<td>-$9.50</td>
<td>-26.0%</td>
</tr>
<tr>
<td>Iron Ore</td>
<td>US$/tonne</td>
<td>$54.50</td>
<td>$60.00</td>
<td>-$5.50</td>
<td>-9.2%</td>
</tr>
<tr>
<td>Coal (Newcastle)</td>
<td>US$/tonne</td>
<td>$55.65</td>
<td>$60.45</td>
<td>-$4.80</td>
<td>-7.9%</td>
</tr>
<tr>
<td>Lithium Carbonate</td>
<td>RMB/tonne</td>
<td>$160,000.00</td>
<td>$50,500.00</td>
<td>$109,500.00</td>
<td>216.8%</td>
</tr>
</tbody>
</table>

Source: Thompson Reuters DataStream Professional
Coal decreased by 7.9% during the year, predicated on weak demand and excess supply. These surplus conditions are expected to remain as demand from the US, India and China remains weak. As the largest consumer of coal, China’s demand has fallen as power usage slows, other electricity sources are explored, and government policies seek to limit coal use to reduce pollution.

The growing production of natural gas from shale formations in the US has made gas cheaper relative to coal for US power generation.

A number of the industrial metals had a poor year with copper and nickel in particular falling more than 15.9% and 21.2% respectively since June 2015. The copper market remains oversupplied, and is expected to remain so as demand from China slows due to cost cutting and substitution. The main issue in the nickel market is also oversupply, and concerns from a demand perspective given the decrease in stainless steel production, which accounts for roughly two-thirds of nickel demand. That said nickel did experience a rebound towards the end of the year which may bode well for the year ahead.

The late rally was reflective of supply side pressures, namely the resurgence of militancy in Nigeria and wild fires in Canada crippling oil sands production. US oil production fell in December year-on-year, with the US Energy Information Administration (EIA) predicting falling output and tighter financing as low oil prices start to impact onshore US production.

Iron ore prices decreased steadily during the first half of the year to reach a low of US$38/tonne in December 2015, mainly due to surging exports from Australia and China’s declining appetite. Stimulus policies launched by China and the prediction of increased steel production saw a rapid response with pricing reaching a high of US$71.5/tonne in April 2016, before stabilising to finish the year at US$54.50/tonne. New production (i.e. Roy Hill) was balanced by the exit of high cost producers and the fact that Chinese iron ore stockpiles had reached a 14-month high in May 2016, which will most likely constrain any further price appreciation in the near term.

Gold and silver prices increased by 13.0% and 18.0% respectively during the year. Uncertainty regarding the impact on European, especially the UK following the recent Brexit vote fuelled uncertainty among investors leading to safe-haven buying. Gold and silver enjoyed a stellar performance over the past 12 months as global institutions increased their allocation of these metals due to global economic instability. Silver saw its biggest price increase during January and February, which was a result of increases in the demand of products such as renewable energy and silver coins. Coupled with these stronger gold prices, Australian-based producers have also benefited from the weakening Australian dollar.

Crude oil prices fluctuated significantly during the year. Despite an overall 17.0% drop, in mid-January prices were US$30/bbl as a result of supply growth from the US, Canada, Russia, OPEC plus the lifting of Western sanctions against Iran, which outstripped demand growth and drove oil to a low of US$30/bbl. Prices did however rebound and settled at the back end of the year at US$49.98/bbl.

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Aluminium dropped 0.5% during the year, facing the same oversupply woes that have dogged other commodities. The global outlook remains positive due to the versatility and favourable uses of aluminium, despite the reduction in demand in China’s property and manufacturing sectors. Zinc dropped to US$1,400/tonne in January 2016, however since then zinc has rallied to finish above US$2,100/tonne by June 30. Zinc prices strengthened on the back of mine closures and structural supply constraints tightening the market and supporting increased prices. In a similar fashion to industrial metals above, lead slumped to US$1,500/tonne in December 2015 before rebounding and finishing at US$1,785/tonne, up 2.4% for the year. Storage batteries account for around 90% of worldwide lead use, and demand for these has slowed through a drop in purchases of industrial batteries and vehicles. However, the price has remained stable through strong supply fundamentals with many major suppliers cutting production.

During the month of March 2016, tin prices increased 7.2% due to the closure of Bangka Tin, plus buoyed by the Indonesian export cuts which pushed the metals stockpiles down. In April 2016, tin continued to rally as China announced cuts in production. Overall, tin rose 22.8% during the year, following news that nine of the major Chinese producers would reduce production by 18,000 tonnes by the end of the calendar year.

The price of platinum and palladium fell by 6.4% and 13.0% respectively over the past 12 months. The metals are highly correlated, with platinum used to reduce emissions in diesel-powered engines and palladium used to do the same in petrol-powered engines. The big event for platinum during the year was the Volkswagen scandal, which occurred in September 2015 and saw platinum dive by 9.2% for the period, but the price picked up again after the markets regained confidence. However with recycling accounting for 25% of global supply, the high stockpiles, USD strength and health concerns regarding the higher levels of pollutants released by diesel engines, platinum continues to suffer from negative sentiment. Palladium pricing has been constrained by the expectations of a shift to electric cars, which has caused a lack of demand from China and other emerging markets.

Uranium was the worst performer during the period, in contrast to the previous year when the commodity showed the largest increase. Uranium prices dropped by 26.0%, closing the financial year at US$27.00/lb, down from US$36.50/lb a year ago. The lacklustre performance has been noticed locally as the average price of uranium is considered too depressed to develop or operate a mine in Australia. The Nuclear Royal Commission has suggested that current uranium prices are unlikely to increase until 2018 given that uranium is forecast to remain in oversupply.

Lithium has increased significantly by 216.8% over the past year. The lithium article within this edition explores the fundamental overview of the lithium market, which has sparked significant interest from investors over the past 12 months.
Powering up – is a boom in lithium production and demand really coming?

**Fact or fiction** – is the lithium story all hype or does the information support it being a commodity that will, after the dust settles, continue to attract ongoing investment and development?

**Overview of the current lithium market**
As with any commodity, the facts about lithium centre on the economics of supply and demand. There has been much written recently about the factors impacting lithium demand. The major driver of the expected increase in demand is first the anticipated exponential growth in electric vehicles which use lithium-ion batteries and secondly (albeit at this stage to a much lesser extent) the use of lithium-ion technology for electrical energy storage systems. This can be attributed to one company - Tesla - and the unprecedented demand for its electric vehicles and the promoting of the Tesla Powerwall. In the first week alone of the launch of its Model 3 electric vehicle on 31 March 2016, Tesla received more than 325,000 reservations. Reservations are now nearing 400,000, even though first delivery is not expected until late 2017.

There is of course more to it than the number of Tesla Model 3 reservations and Powerwall modules ordered. The last 10 to 15 years has already seen an increase in demand for lithium-ion batteries, with the ever-growing market for mobile phones, laptop computers, tablets and other rechargeable products. Interestingly though, even with this upsurge in electronic devices, the greatest usage of lithium today is still in ceramic and glass and other industrial products. To date the major suppliers have been able to readily deal with this increased demand.

While not knowing what the future will look like, at least understanding what it could look like will give some context to the lithium story. Of central importance is whether lithium-ion batteries will continue to be the preferred choice of ‘storage’ or be superseded by new and/or emerging alternatives. There is also the supply side and whether any barriers to entry will keep the supply of lithium firmly in the hands of the major producers who currently control, it is reported, 90% of the market.

**Size of the lithium market**
In 2015, the lithium market, using lithium carbonate equivalent (LCE) as a measure, was estimated to be approximately 170,000 tonnes. Of this, approximately 35% to 40% of lithium was used in lithium-ion batteries, with the balance being used in ceramic, glass and other industrial applications. There is a range of research forecasting growth in lithium demand to be between 270,000 to 340,000 tonnes LCE by 2020, with more than 50% being used in lithium-ion batteries. Looking further out to 2025, the research indicates the demand for LCE growing to between 500,000 to 600,000 tonnes, with demand for lithium-ion batteries accounting for 65% to 70%. It is not surprising, even when taking the lower end of the forecasts for LCE in 2020 and 2025, that this has created hype about the economics of lithium and whether supply will be able to match the ever-increasing demand.

In a mining/energy and resources market where significant activity has been absent across most commodity players, in particular exploration and junior miners, the emergence of lithium has at least breathed life into this sector.

For many, it is almost a moot point whether its potential is fact or fiction, as what it has done has re-ignited the entrepreneurial spirit that the commodities sector has been missing over the past few years. It has seen the badly needed injection of capital into the small to mid-end of the market that in turn creates new activity across the various market participants and so the cycle starts and momentum gains.

But the optimism is not just confined to the small to mid-end of the market. While some of the major global mining companies still consider the lithium market too small to arouse their interest, Rio Tinto has bucked that trend and recently said that its Jadar Lithium-Borate project in Serbia will be a strategically important project for its mineral business.
In June 2016, Norway proposed new laws to ban the sale of new petrol and diesel cars by 2025 and this is believed to extend to HEVs, which means only EVs will be able to be purchased from that time onwards. The major political parties who were previously unable to agree on this legislation have now reportedly reached an accord on these proposed laws and they are expected to be passed.

In April, the German government announced a €1.2b incentive program to boost the sale of electric vehicles, offering consumers as much as €4000 in rebates to help offset the higher price of an electric vehicle. In making this announcement, the German Finance Minister said “the goal is to move as quickly as possible on electric vehicles”. The German government’s plan is to have more than one million electric vehicles on its streets by 2020.

The US government has rebate incentives of between US$7,500 and US$10,000 in place for the purchase of electric vehicles. This is to support President Obama’s objective for the US to also have more than one million electric vehicles on its streets by 2020.

As the research suggests, the excitement around the lithium market is amplified when considering the impact on the demand for lithium if there is a significant take up in the use of electric vehicles and the continued successful development of electrical energy storage systems.

The electric vehicle
Understanding the impact of electric vehicles as a source of the increased demand for lithium is not straightforward. There are two categories of electric vehicles - the hybrid electric vehicle (HEV) and the fully electric vehicle (EV). The HEV uses an internal combustion engine as its main source of propulsion, whereas in an EV, the battery is responsible for all or most of the power consumption.

While the HEV doesn’t provide any major anxiety for the driver, the EV historically does with anxiety over the amount of power and the distance range before charging is needed. Continued advancement in the technology is seeing this anxiety subside as the power and distance range is addressed. While increased uptake in HEVs will have a modest impact on the demand for lithium in the future, the real game changer for lithium is if there is a significant increase in the uptake of EVs in the future.

This is because in an EV the power output from a lithium-ion battery needs to be significantly higher than a HEV (meaning it needs a bigger battery). This in turn means much higher lithium content in the battery and that content increasing as the power and range limitations are dealt with. On a relative comparison basis, there is approximately 10 times more lithium content in the battery of an EV than a HEV.

Even though continued uptake in the use of HEVs will have an impact on the future demand for lithium, it is the prospect of the forecast uptake in EVs that is causing, by far, the biggest impact on the lithium market. While the uptake of EVs has been modest, with 2015 production estimated to be 150,000 (which itself has nearly doubled since 2013), forecasts indicate that this uptake could increase to production of more than one million EVs in 2020. This level of production is estimated to require 75,000 tonnes of LCE (remembering that total lithium consumption across all applications in 2015 was estimated to be 170,000 tonnes LCE).

Only time will tell whether the take up of the EV is more or less than forecast. The potential for ‘more’ is certainly creating high expectations. Again, while it remains uncertain, these expectations are not without some foundation as the world looks to the use of clean energy and governments around the globe continue to increase investment in both incentives and infrastructure to support the uptake in EVs.

By way of example:

- In late 2015 a requirement was set in China that all new residential buildings with parking spaces be outfitted with charging stations for electric vehicles and that at least 10% of large public buildings and parking lots also be fitted with charging stations.
- There is continuing speculation in China that the government may introduce an air pollution levy in coming years to narrow the cost of ownership between EVs and traditional vehicles.
- In June 2016, Norway proposed new laws to ban the sale of new petrol and diesel cars by 2025 and this is believed to extend to HEVs, which means only EVs will be able to be purchased from that time onwards. The major political parties who were previously unable to agree on this legislation have now reportedly reached an accord on these proposed laws and they are expected to be passed.
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Due to its much shorter lead time to production, it is considered that lithium sourced from hard rock mineral can respond more rapidly to price rises caused by increasing demand.

It is commonly known that lithium is abundant and that there are fairly large numbers of both lithium mineral and brine deposits, although identifying deposits of sufficient grade and quantity has been a barrier to commercialising them, as have environmental constraints, in particular with regard to brine deposits in South America. So while lithium is not resource constrained, the profitable extraction of lithium has been a challenge.

However, technological advances are also playing a part in the potential supply of lithium. Traditionally, spodumene has been the dominant lithium-bearing mineral sought after and processed because of its higher lithium content. But advances in technology have the potential to significantly reduce the costs of processing and thereby potentially make other minerals with lower lithium content, such as lepidolite, more economic.

Electrical energy storage

In looking at many of the lithium forecasts for 2020 and 2025, while electric vehicles have the single greatest impact, the next greatest impact (albeit far more modest), is attributed to the uptake in electrical energy storage systems.

The use of lithium-ion batteries as the source of power across consumer electronics such as mobile phones, tablets, portable computers, power tools etc., has been generally well accepted. This has had and will continue to have an ever-increasing impact on the demand for lithium. But the real material upside for energy storage relates to grid scale storage and/or taking consumers off the energy grid.

For the renewable energy sector, electrical energy storage has been the ‘holy grail’ and recent advancements and continuing research and development seem to be making this more attainable. Electrical energy storage potentially provides a solution, allowing renewable energy generators to store energy in grid scale storage and thus becoming less intermittent and less dependent on intermittent energy sources. As stated by SA Power Networks “We have a looming network constraint. At some point we would have to upgrade the lines, so we are taking the opportunity to do this trial". SA Power Networks will monitor the results of the trial to assess whether the use of storage batteries in residences will help deal with capacity constraints in the current grid network.

The supply side

Looking at the factors that will possibly impact future lithium demand is critical, but so is assessing the supply side. In 2015, the supply side was dominated by four major producers controlling more than 90% of the market. Tianqi Lithium (the 51% majority owner of the Talison Lithium mine at Greenbushes, which currently produces about a quarter of the world’s lithium supply) is the largest of the four producers. The other three producers are Albermarle (which by virtue of acquiring Rockwood holds the other 49% of the Talison Lithium mine at Greenbushes), SQM and FMC.

Lithium can be sourced from brine - which is the dominant source in South America - and also from hard rock minerals. Brines are typically regarded as cheaper to extract, but can be more capital intensive and require greater lead times to production. Hard rock operations have higher operating costs, can be less capital intensive but - importantly - can have much shorter lead times to first production.

As an indicator of how electrical energy storage technology can disrupt traditional off the grid power supply, SA Power Networks announced in May 2016 that it would trial storage batteries in an effort to defer a $3m network upgrade. It plans to sell deeply discounted Tesla and Samsung home storage batteries (both of which use lithium-ion technology) to 100 households. As stated by SA Power Networks “We have a looming network constraint. At some point we would have to upgrade the lines, so we are taking the opportunity to do this trial". SA Power Networks will monitor the results of the trial to assess whether the use of storage batteries in residences will help deal with capacity constraints in the current grid network.

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How the supply side and both existing producers and new producers can respond to the expected increase in demand will go a long way to determining the future of many other emerging lithium producers.
Fact or fiction (or both)
If the forecasts for the increase in the use of electric vehicles are correct, then it is quite realistic to expect a significant increase in the demand for lithium. This will only be enhanced if the demand for grid or electrical energy systems continues to gather momentum.

The fiction or unknown side of this equation remains in the reality that only a very small percentage of those companies now claiming to be ‘in lithium’ will actually ever get to the stage of having something that represents a potential commercial lithium resource. That is not to say that most of them don’t have an important part to play in the lithium market because, as we know, without exploration, the next commercial resource will not be found.

The emerging Australian producers
While we have mentioned the major players with varying degrees of capacity to increase supply, there are a number of other companies who have either started to produce lithium or will have by the end of 2016. This will ensure any continued upsurge in lithium demand will be met in the near term. Not far behind is another tier of companies that expect to begin producing in the next one to five years. Beyond this tier are a significant number of companies (including many junior explorers) joining the rush to be part of the lithium story.

From an Australian perspective, the companies with Australian operations that fall into the more advanced categories include Galaxy Resources/General Mining and its Mt Cattlin project and Neometals/Mineral Resources and its Mt Marion project. Both projects commenced mining in 2016.

Pilbara Minerals’ Pilangoora project and Altura Minerals’ Pilangoora project followed. Both are at varying stages of completing a DFS.

There are also many Australian companies in the initial stages of trying to identify lithium bearing-minerals and breathe life into their future aspirations of being a lithium mining company.

Tim Richards
WA Clients & Markets Partner
Tel: +61 8 9365 7248
atrichards@deloitte.com.au

The excitement around the lithium market is amplified when considering the impact on the demand for lithium if there is a significant take up in the use of electric vehicles and the continued successful development of electrical energy storage systems.
Where to from here?
Innovation in Mining

Learning to use the right methods, tools and approaches at the right times

We are going through one of the most intense periods of change our small blue planet has ever seen. During such times, the ability to innovate – to evolve, adapt, and improve – is indispensable.

As a nation, Australia is positioned 17th out of the 141 countries in the Global Innovation Index, yet it is the resource-limited countries such as Switzerland, UK, Sweden and the Netherlands that are the most innovative, implying that they have had to find alternative ways to progress, which include creating, using and sharing information and knowledge in the form of innovation. What can we as a nation and as a mining industry learn from them?

One of the unfortunate consequences of the mining industry’s focus on maximising volume (to exploit high commodity prices) during the boom phase of the cycle, was that significant inefficiencies became deeply embedded in operations, organisational structures and in the back office functions of mining companies of all shapes and sizes.

So when the cycle turned, the industry developed an unrelenting and often brutal focus on removing cost. Following a period that saw the disposal of poorer performing assets, deferring of new capital projects, reorganisation, headcount reductions and accelerated continuous improvement programs, Deloitte’s own recent research suggests that the mining industry could be confusing operational excellence and continuous improvement with true innovation. No surprise that the industry appears to be now asking where to from here?

There is broad acknowledgement of the need to be working smarter and that the next wave of productivity and growth opportunities will come from doing things differently. It’s not unexpected then, that the mining industry appears to have embraced innovation as a godsend in the face of an uncertain outlook for commodity prices, but where is the real innovation that will continue to drive productivity and growth?

Our own research has shown that high performing companies do certain things well around the innovation agenda and that top innovators also outperform the S&P 500 in relation to how many different types of innovation they pursue (refer to graph below). Deloitte’s work over the decades has shown that using the Ten Types of Innovation demonstrably increases innovation hit rates. It helps companies to generate innovations that earn disproportionate returns and are more difficult for competitors to copy.

We hear the message “We need to embrace innovation to drive productivity and growth” repeatedly from mining companies, and good examples are often cited such as automation and remote operations centres, but haven’t these now become the norm?

5 year indexed stock price returns of the top innovators vs. S&P 500
Some of the most powerful innovators in history, ranging from GE to Honda to Google, have connected involvement in innovation initiatives to career development, incentives and promotion — because innovation is what they expect from their future leaders. Innovation also becomes an investment that we start funding programmatically, instead of scraping budget dollars together each quarter, because it’s vital to the ongoing health and success of our business. We stop hoping innovation will happen and start requiring it from each other and ourselves.

In summary, if the mining companies are going to embrace innovation to drive productivity and growth, they will need to embed innovation as a discipline and think about innovation in a more systemic way. Then we can expect to see more companies building breakthrough innovations — those game changers that enable leading innovators to be top performers that generate superior returns for their shareholders.

Anyone can (and should) learn to innovate and, with practice, anyone can become better at innovating. Simply put, there is no longer an excuse not to innovate.
A key step in the process of managing mining inventory is to accurately assay its composition and location in a geographically large pipeline. Novel ways to quantify inventory are emerging, such as the use of drones to survey inventory and to monitor equipment.

Supply chain management of operating goods should also be incorporated into the predictive analytics pipeline. Dynamic quantification of consumables such as diesel, explosives and depreciable components will support operational decisions and provide high resolution understanding of the real-time costs of production.

Dynamic monitoring by closed-loop systems
Closed-loop monitoring integrates closely with JIT inventory to monitor supply chain. Maintenance and repair inventory are now overseen like never before. Sophisticated and extremely small sensors can be installed to monitor virtually any physical and physicochemical property that may impact on the function or lifetime of a component, creating a closed-loop monitoring system.

Time-to-death modelling, or survival analysis, is employed to optimise maintenance schedules. Replacing a component too late in its life cycle can lead to failure of the product, yet too early, could significantly increase unnecessary maintenance costs, magnified over thousands of components could lead to significant financial waste.

Can mining companies use these insights to become more agile? Changes in mining aren’t nearly as rapid because the environment is constantly variable, a stark contrast to the laboratory-like conditions where processing chips are manufactured and consumer technology assembled.

In parallel with the maturation of advanced manufacturing comes a critical period in mining. The period of elevated global commodity prices forced miners to produce, rather than innovate. Now, the combination of slower global growth and increases in world-wide commodity production has exerted downward pressure on prices, placing the need for operational efficiencies in sharp focus.

Just-in-time inventories
Just-in-time (JIT) inventory is an established method for lowering total inventory and costs while reducing waste, inefficiencies and disruptions on the manufacturing pipeline. It has the capacity to provide real-time asset values and optimised maintenance and repair schedules across each component of the inventory.

Maintaining an accurate and precise inventory using integrated sensing or automated surveying wherever feasible is a critical step in advanced manufacturing. Digital tagging and monitoring of inventory ensures items are accurately quantified, allocated and replaced when required. Data is continuously and progressively modelled to ensure inventory optimisation and supply chain management. Real-time information can be provided to suppliers and customers, which may also reduce their costs by reducing volatility, holding costs and delivery times.

Mining operations sprawl across massive areas and diverse and changeable landscapes.

Advanced manufacturing – a harbinger for the mining sector

In fewer than two decades manufacturing has fundamentally changed from labour intensive mechanical processes, to a complex series of information technology based procedures. The process from design to delivery is digitally managed and inextricably integrated to optimise the manufacturing pipeline.

Advanced manufacturing is managed on a process where rationalisation is data driven. The acquisition, transmission, storage and analysis of that data knows no limits. Combined with significant advances in computational processing power, this has enabled the dynamic monitoring and interrogation of components, and states, at all points in the advanced manufacturing pipeline.

The rapid evolution of consumer products comes at an eye-watering pace. Changing demands have forced the continual technology driven changes in advanced manufacturing. But how applicable to mining are the lessons and the techniques?
The combination of slower global growth and increases in worldwide production has exerted downward pressure on commodity prices, placing the need for operational efficiencies in sharp focus. A more sophisticated and agile approach to asset management, plant design and maintenance, inventory management and supplier relationships will be needed if companies are to continue to return value to shareholders and compete globally.

The manufacturing industry has undergone a fundamental shift in its operations and is now an exemplar of flexibility, productivity, accuracy, technological sophistication and constant evolution on both large and small scales. Technology is continuing to advance across all sectors, presenting a golden opportunity to understand the translational potential of advanced manufacturing in the mining sector.

Managing supplier ecosystems
Suppliers have their own operating decisions to make, model and optimise, yet are expected to provide good value products as and when required. A smoothly operating supply chain is critical to the smooth operation of a mine site, particularly under a JIT system, where inventory is managed at optimal levels.

The acquisition and modelling of mine site operational data should be leveraged to support existing supplier ecosystems. Keeping the supplier informed in real time could improve their capacity to deliver products on-time and on budget, likely reduce their operating costs and provide an excellent foundation for negotiating future contracts.

Personalised ore
Where the composition of ore is quantified in transit, assayed during drilling or estimated by the level of destruction caused by explosives, would a customer pay above the odds for personalised ore? Understanding a customer’s needs and the impact certain ore types have on the depreciation of their assets may be a key advantage in increasing margins and getting ahead of the pack. Manufacturing has been manoeuvred into such a position by the fickle consumer, treating high-value and sophisticated items as disposable at the most convenient opportunity. But, could the mining sector sway the interest of a key client to charge a premium?

In using and understanding the dynamic part of the inventory, its composition and location at any one time, could minor structural changes be made to the mobilisation of the desired ore? Avenues for opening up potentially profitable markets and the structural changes to implement them should be keenly explored.

Using plant design to improve production
A hallmark of advanced manufacturing is the assimilation of product design within all stages of the design of the pipeline. Product design includes the planning, optimisation and maintenance capabilities of all machinery required to fabricate a product. At no point do these processes become separated. Components required for depreciating machinery are exquisitely detailed during the factory design and factory commissioning process and changes are engineered with accuracy and precision.

In mining, however, the commissioning of a plant may be accompanied by a change in contractor and loss of detailed information on plant equipment, parts, maintenance schedules and logged jobs. Loss of information can be a key driver of increased costs. While forming an important part of the production process, precision in plant maintenance is an inefficient and costly art that can and must be improved.

Personalised ore
Where the composition of ore is quantified in transit, assayed during drilling or estimated by the level of destruction caused by explosives, would a customer pay above the odds for personalised ore? Understanding a customer’s needs and the impact certain ore types have on the depreciation of their assets may be a key advantage in increasing margins and getting ahead of the pack. Manufacturing has been manoeuvred into such a position by the fickle consumer, treating high-value and sophisticated items as disposable at the most convenient opportunity. But, could the mining sector sway the interest of a key client to charge a premium?

In using and understanding the dynamic part of the inventory, its composition and location at any one time, could minor structural changes be made to the mobilisation of the desired ore? Avenues for opening up potentially profitable markets and the structural changes to implement them should be keenly explored.

Using plant design to improve production
A hallmark of advanced manufacturing is the assimilation of product design within all stages of the design of the pipeline. Product design includes the planning, optimisation and maintenance capabilities of all machinery required to fabricate a product. At no point do these processes become separated. Components required for depreciating machinery are exquisitely detailed during the factory design and factory commissioning process and changes are engineered with accuracy and precision.

In mining, however, the commissioning of a plant may be accompanied by a change in contractor and loss of detailed information on plant equipment, parts, maintenance schedules and logged jobs. Loss of information can be a key driver of increased costs. While forming an important part of the production process, precision in plant maintenance is an inefficient and costly art that can and must be improved.

The mining sector needs to be agile in its response to the challenge of lower commodity prices.

The combination of slower global growth and increases in worldwide production has exerted downward pressure on commodity prices, placing the need for operational efficiencies in sharp focus. A more sophisticated and agile approach to asset management, plant design and maintenance, inventory management and supplier relationships will be needed if companies are to continue to return value to shareholders and compete globally.

The manufacturing industry has undergone a fundamental shift in its operations and is now an exemplar of flexibility, productivity, accuracy, technological sophistication and constant evolution on both large and small scales. Technology is continuing to advance across all sectors, presenting a golden opportunity to understand the translational potential of advanced manufacturing in the mining sector.

Managing supplier ecosystems
Suppliers have their own operating decisions to make, model and optimise, yet are expected to provide good value products as and when required. A smoothly operating supply chain is critical to the smooth operation of a mine site, particularly under a JIT system, where inventory is managed at optimal levels.

The acquisition and modelling of mine site operational data should be leveraged to support existing supplier ecosystems. Keeping the supplier informed in real time could improve their capacity to deliver products on-time and on budget, likely reduce their operating costs and provide an excellent foundation for negotiating future contracts.

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The mining sector needs to be agile in its response to the challenge of lower commodity prices.

For example, using a database of log books and maintenance schedules, sophisticated models could be produced to identify the most likely period of failure for each component. In addition, sensors could be placed on assets to monitor a variety of properties, such as vibration detection systems, that could identify unusual patterns prior to unexpected breakdown failures, reducing damage caused by failures.

Ultimately, the modelling will synchronise maintenance schedules and optimise the use of mechanics’ time, identify properties that place assets at risk, in parallel with managing inventory components and supply chain schedules.

Tim Perkins
Senior Consultant - Consulting
Tel: +61 8 9365 7161
tperkins@deloitte.com.au
Creating sustainable cost savings using data analytics

All aspects of costs are under scrutiny, from the efficiency of physical operations through to business support processes. But the low-hanging fruit has largely been harvested and driving further sustainable cost savings now requires more innovative approaches.

Data analytics is an industry leading resource that, when used effectively, can highlight process improvements in businesses that will identify and drive sustainable cost savings. Data analytics can be applied across the entire spectrum of any organisation’s operations, from physical operations through to business support processes.

In this article we will focus on the cost saving opportunities that can be identified within business support processes through data analytics.

Frequently, companies tackle costs in business support processes by simply cutting headcount.

However, headcount reductions, especially in corporate areas, are often in response to generalised reviews based on benchmarks and a belief that headcount reductions will force cost savings.

Are these cost cuts sustainable? Short answer – probably not. Experience has shown that simply cutting heads but not redesigning processes does not result in sustainable cost savings.

Resource companies globally are relentlessly cutting costs in the face of dramatic falls in commodity prices.
Case studies - examples of applications

Employee costs – payroll leakage analysis
Using data analytics, information can be drawn from human resource systems, payroll and timesheets, which is then analysed to look for cost leakage and subsequent opportunities for cost reduction from anomalies against workplace agreements, leave entitlements, hourly rates, step-up rates, allowances, overtime, superannuation and timesheet hours.

Experience suggests expected cost savings of 1% to 2% of payroll spend for wages and casual workers.

Procurement and payables analytics
Data from vendor master files and transactional data including purchase orders, invoices, payments and credit notes can be used to build spend profiles, identifying which vendors are used, the spread and stratification of vendors, commercial terms, payment terms, and payment timing.

Experience shows that key tactical opportunities to reduce costs include:
- Acceleration of delayed input tax (GST) claims
- Identifying unclaimed diesel fuel tax credits
- Vendor payment terms and payment timing analysis
- Supplier overpayments
- Duplicate payments
- Supplier rationalisation and consolidation.

The ‘slash and burn’ approach results in temporary reductions in costs. But often, cultural engagement surveys report reductions in employee engagement levels, drops in performance, and declining morale as the remaining staff attempt to tackle the same workload without sufficient resources.

The outcome can be that control gaps appear, risk increases, and ultimately staff and contractors are re-employed to plug the holes, undoing any initial savings. The key to creating sustainable cost savings is to re-design processes with the philosophical approach of ‘what must go right’ and ‘what can we stop doing’ rather than ‘what can go wrong’ and ‘what must we do to prevent it’.

Data analytics has proven to be a powerful tool to identify both ‘what must go right’ and ‘what can we stop doing’ in order to help design more efficient processes and support sustainable cost savings.

One of the most important advantages of data analytics is the ability to look at a whole population, instead of a sample of transactions.

Overall approach for data analytics
From a whole population, data analytics can identify anomalies in business processes. These anomalies can then be investigated in order to identify opportunities for process change, cost savings, and improvements.

1. Setup and early insights
- Gather, review and input data from various systems into the analytics engine
- Review and configure standard process terms in analytics engine
- Conduct initial analysis to derive high level insights.

*View on the approximate scale of the cost reductions that are possible.*

2. Deep-dive and granular insights
- Run detailed analytic tests to identify exceptions and non-compliance
- Validate findings against baseline business operations
- Derive granular insights and areas of primary optimisation.

*Validation of the value of a portion of these opportunities.*

3. Roadmap and savings identified
- Run detailed analytic tests to identify exceptions and non-compliance
- Validate findings against baseline business operations
- Derive granular insights and areas of primary optimisation.

*Prioritised roadmap of validated savings opportunities.*
In the longer term, strategic opportunities can also be found. Leading edge practices include strategic sourcing partnerships with key suppliers, virtual and shared warehouses, joint ventures and joint development projects to help drive innovation.

**Warehouse inventory optimisation**

Warehouse inventory management is how organisations provide the right materials and supplies in the right quantities and at the right locations, to meet the supply and demand of spare parts and materials to efficiently maintain the plant and equipment of the business.

However, the significant volume of inventory data and the complexity of the analysis required to optimise inventory levels in alignment with maintenance needs can create many opportunities for improvements.

Common issues can include:

- Inconsistent definition and application of inventory criticality ratings resulting in higher than necessary safety stock and replenishment levels
- Poor master data management results in inventory with no criticality ratings assigned and incorrectly categorised inventory
- Inventory management operating in isolation of procurement and maintenance planning and activities, resulting in unexpected and adverse impacts on inventory holdings and long-term costs
- Lack of appropriate inventory KPIs to drive desired inventory management practices.

Data analytics can assist organisations optimise their inventory leading to potential cost savings, including:

- Reducing inventory carrying costs and releasing working capital ‘locked up’ in slow moving or excessive inventory
- Controlling inventory growth
- Ensuring sufficient levels of critical spares to minimise disruption to operations
- Limiting unexpected inventory obsolescence write-downs.

**Fixed assets**

Energy and resources companies generally run large fleets of mobile equipment, operate complex plants and infrastructure and manage long-lived assets. Often the assets are refurbished, repaired, and partly rebuilt, which results in complex fixed asset register recording. Adding to the complexity are the varying rules around tax depreciation and asset useful lives.

Applying detailed data analytics to fixed asset registers can identify the following opportunities:

- Orphaned assets and depreciation irregularities
- Correct and accelerate sub-optimal tax depreciation schedules
- Develop a single ‘source of truth’ from multiple asset registers
- Simplify complex registers.

**Conclusions**

Opportunities to apply advanced data analytics techniques to drive the next level of sustainable process changes and cost savings are certainly there. Will mining companies take the next step to creating sustainable cost savings?

Michael Barrett
Energy and Resources Risk Leader Partner – Risk Advisory
Tel: +61 8 9365 7034
micbarrett@deloitte.com.au
### WA’s top 100 listed companies

As at 30 June 2016

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Source: Capital IQ and ASX websites
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Source: Capital IQ and ASX websites
WA’s top 100 listed companies (As at 30 June 2016)...continued

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Source: Capital IQ and ASX websites
WA's top 100 listed companies (As at 30 June 2016)...continued

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Source: Capital IQ and ASX websites
Compilation of the Deloitte WA Index

For information regarding the Deloitte WA Index, please contact:

**Tim Richards**  
Tel: +61 8 9365 7248  
atrichards@deloitte.com.au

**David Newman**  
Tel: +61 8 9365 7178  
danewman@deloitte.com.au

**Perth office**  
Tel: +61 8 9365 7000  
Fax: +61 8 9365 7001

The monthly Deloitte WA Index is compiled from publicly available information provided by the ASX and Capital IQ on the market capitalisation of each Western Australian listed company.

A company is included as a Western Australian company where its registered office is listed in Western Australia, regardless of whether the company is dual listed. The information on Western Australian listed companies is extracted and then summarised to provide a cumulative market capitalisation figure for all Western Australian listed companies.

The base period of the Deloitte WA Index is May 2000 and for the purposes of the Index the month of May 2000 is given a notional value of one. All subsequent monthly cumulative market capitalisation totals are divided by the May 2000 total to then obtain a relative movement. Please note that if a company has been suspended or delisted during a particular period no data will be included for that month and all subsequent months until the company is re-listed or the suspension lifted. Historical information regarding the company’s market capitalisation will continue to be included in the calculation of the Index.

Earnings per share (EPS) is a basic calculation, i.e. net profit divided by weighted average number of shares.

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Contact us

Nicki Ivory
National Mining Leader
Lead Partner – Financial Advisory
Tel: +61 8 9365 7132
nivory@deloitte.com.au

Leanne Karamfiles
Lead Partner
– Assurance & Advisory
Tel: +61 8 9365 7234
lkaramfiles@deloitte.com.au

Richard Thomas
Lead Partner
– Risk Advisory
Tel: +61 8 9365 7024
richathomas@deloitte.com.au

Tim Richards
Clients & Markets Partner
– Western Australia
Tel: +61 8 9365 7248
atrichards@deloitte.com.au

David Cormack
National Mining Leader
– Consulting
Tel: +61 8 9365 7071
dcormack@deloitte.com.au

Phil Hopwood
Global Mining Leader
Tel: +1 613 851 0028
pjhopwood@deloitte.ca

Mike Lynn
Lead Partner
– Consulting
Tel: +61 8 9365 7125
mlynn@deloitte.com.au

Jonathan Schneider
Lead Partner
– Tax
Tel: +61 8 9365 7315
joschneider@deloitte.com.au

Michael McNulty
Office Managing Partner
– Western Australia
Tel: +61 8 9365 7055
mmcnulty@deloitte.com.au

Nicki Ivory
National Mining Leader
Lead Partner – Financial Advisory
Tel: +61 8 9365 7132
nivory@deloitte.com.au

Leanne Karamfiles
Lead Partner
– Assurance & Advisory
Tel: +61 8 9365 7234
lkaramfiles@deloitte.com.au

Richard Thomas
Lead Partner
– Risk Advisory
Tel: +61 8 9365 7024
richathomas@deloitte.com.au

Tim Richards
Clients & Markets Partner
– Western Australia
Tel: +61 8 9365 7248
atrichards@deloitte.com.au

David Cormack
National Mining Leader
– Consulting
Tel: +61 8 9365 7071
dcormack@deloitte.com.au

Phil Hopwood
Global Mining Leader
Tel: +1 613 851 0028
pjhopwood@deloitte.ca

Mike Lynn
Lead Partner
– Consulting
Tel: +61 8 9365 7125
mlynn@deloitte.com.au

Jonathan Schneider
Lead Partner
– Tax
Tel: +61 8 9365 7315
joschneider@deloitte.com.au

Michael McNulty
Office Managing Partner
– Western Australia
Tel: +61 8 9365 7055
mmcnulty@deloitte.com.au

Nicki Ivory
National Mining Leader
Lead Partner – Financial Advisory
Tel: +61 8 9365 7132
nivory@deloitte.com.au

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Lead Partner
– Assurance & Advisory
Tel: +61 8 9365 7234
lkaramfiles@deloitte.com.au

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– Risk Advisory
Tel: +61 8 9365 7024
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– Western Australia
Tel: +61 8 9365 7248
atrichards@deloitte.com.au

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– Consulting
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– Tax
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Leanne Karamfiles
Lead Partner
– Assurance & Advisory
Tel: +61 8 9365 7234
lkaramfiles@deloitte.com.au

Richard Thomas
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– Risk Advisory
Tel: +61 8 9365 7024
richathomas@deloitte.com.au
About Deloitte

Our Culture – our essence
Culture at Deloitte does not just happen – we work at it.

It’s the sum total of the actions of our people, it’s the way we treat others – it’s the way we behave. Our seven Signals embody these values. Our passion for teamwork and exceptional client service is our point of difference.

At Deloitte, we live and breathe our culture. Our internationally experienced professionals strive to deliver seamless, consistent services wherever our clients operate.

Our mission is to help our clients and our people excel.

Our Signals

Continuous grow and improve
We have an environment that respects the individual, rewards achievements, welcomes change and encourages a lifetime of learning – with ourselves and our clients.

Have fun and celebrate
There is never a wrong time to celebrate and have fun – recognising, appreciating, acknowledging and learning from the experiences and success shared between our client and Deloitte teams.

Aim to be famous
We aim to reach for the stars – and beyond. To be thought leaders, showcasing our clients and our team’s talent and expertise.

Play to win
Think globally – Winning is our stated objective. It is also our state of mind.

Talk straight
When we talk, it’s open, regular, honest, constructive two-way communication between our people and our clients.

Empower and trust
We encourage a sense of ownership and pride by giving responsibility and delegating authority.

Recruit and retain the best
Our people are talented, enthusiastic, self-starters, team players who are bursting with potential. They are people with whom we have a lifetime association.