

Strengthening
Australia's position
as a global hub for
mining innovation

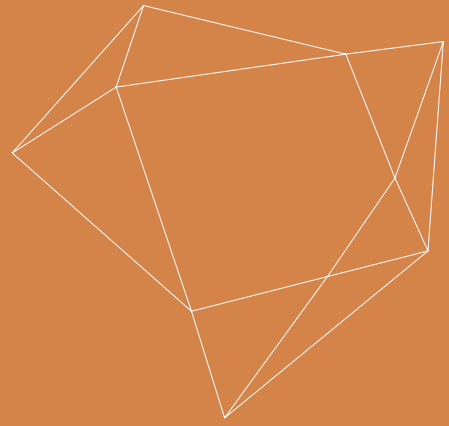
MINING EQUIPMENT TECHNOLOGY SERVICES

10 YEAR SECTOR
COMPETITIVENESS PLAN



Australian Government
Department of Industry,
Innovation and Science

Industry
Growth
Centres



METS Ignited is one of six Growth Centres

The Industry Growth Centre initiative is a new policy direction for Australia, taking an industry-led approach to driving innovation, productivity and competitiveness, by focusing on areas of competitive strength and strategic priority. The initiative aims to enable national action on key issues such as regulation reform, skills, collaboration and commercialisation. It aims to drive excellence, not dependence and seeks to create an economy that ensures Australia's ongoing prosperity.

Growth Centre objectives:

1. Improving management capabilities and workforce skills.
2. Improving the capability of sectors to engage with international markets and global supply chains.
3. Enhancing industry research collaboration and commercialisation.
4. Identifying opportunities for regulatory reform.

METS Ignited wishes to recognise its partners for their strong and valued support and significant contribution to the development of the 2016 Sector Competitiveness Plan (SCP):

- Austmine
- CSIRO
- Department of Industry, Innovation and Science
- Queensland Department of State Development

METS Ignited wishes to thank significant contributors:

- VCI
- Australian Mines and Metals Association

METS Ignited would also like to express gratitude to the many industry representatives, from both the METS and the mining sectors, who gave freely of their time and advice through the consultation process. This input has been invaluable in shaping and prioritising the SCP.

*The vision for the Australian METS industry is **an aligned, collaborative and agile ecosystem and, through leadership and innovation, a growing share of the global market.***

*The **METS Sector Competitiveness Plan** outlines five programs of work to deliver this vision for growth over the next ten years.*

 **Aligned Strategy**

The sector has a compelling vision and strategy that aligns to and enhances the growth needs of the METS, mining and research industries



 **Global Brand**

The Australian METS brand and value proposition is recognised globally, highly valued and priced at a premium



 **Internationally Competitive**

Supply chain participation is facilitated by global partnerships, world class clusters and the active support of capital markets to grow scale needed to compete internationally



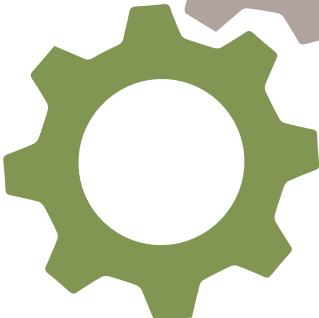
 **Collaborative & Innovative**

Collaboration across the sector has accelerated the rate of both innovation and commercialisation



 **Skilled for 2026**

The skills base enhances business capability and growth, and ensures the sector's sustainability and leadership in a rapidly transforming technology landscape





Starting the Conversation

As you open the pages of this 10-year Sector Competitiveness Plan (SCP), the Australian Mining Equipment, Technology and Services (METS) industry is facing unprecedented challenges – and vast potential.

The very fact that you have taken time to review this, tells us you share our desire to unite and galvanise our industry to ensure its optimum potential globally.

That is what this report is about. It is a vision for this industry that will create a future of smarter relationships and collaborative leadership.

It is a report that aims to start a conversation, it explores and challenges us to think about what is possible and what initiatives could create a different future.

As you undoubtedly know, Australia is blessed with mineral wealth and despite being a young nation has managed to build a world leading, competitive mining industry and METS sector. However, there is much work to be done to develop and enhance this legacy for our nation's future.

Whilst Australia is a key player in mining with major corporations such as BHP Billiton, Rio Tinto, Newcrest, Fortescue Metals Group, South 32, Alumina Ltd, Evolution Mining, MMG and others, we have not yet replicated this leadership in the METS sector.

The Australian mining industry is supported by some of the world's best mining and research organisations and institutions. We believe the opportunity exists for the METS industry to similarly use these resources and work collaboratively to achieve higher market share, greater scale and influence globally.

This SCP is the result of extensive consultation and engagement since the commencement of the METS Ignited Growth Centre in late 2015. It is a living document, and, like a balance sheet, is a reflection of the data and information identified and analysed at a particular time. It is iterative and the clarity of initiatives and required programs of work will develop as the industry and METS Ignited gain deeper engagement and share insights over the next 10 years.

We ask the industry ecosystem, including corporates, customers, researchers and governments to help us define the way forward and to take a lead role in delivering this plan. The first update of the SCP in 2017 will identify key organisations and groups that have volunteered to contribute to and implement these ambitions.

The resounding message received from the consultations was that we need collaboration and better relationships between suppliers and miners to achieve an aligned vision and greater effectiveness. We rely on the outstanding people who make up this industry ecosystem to help deliver a holistic outcome rich with benefit for the sector, the Australian economy and its people.

We have an exciting and unique opportunity, with the support of the Australian Federal Government, to work together positively and collaboratively to develop and lead the METS industry in Australia and internationally.

We look forward to working with you,

Elizabeth Lewis-Gray
Chair

Ric Gros
CEO



Contents

| | |
|------------------------------------------|-----|
| 1: Executive Summary | 6 |
| 2: The METS Industry in Australia | 14 |
| 3: The Changing Face of Mining | 22 |
| 4: The Role of Research | 30 |
| 5: The Challenges Facing the Sector | 34 |
| 6: The Opportunity for the Sector | 40 |
| 7: The Sector Competitiveness Plan (SCP) | 44 |
| Programs of Work | |
| 7.1: Aligned Strategy | 50 |
| 7.2: Global Brand | 60 |
| 7.3: Internationally Competitive | 70 |
| 7.4: Collaborative and Innovative | 80 |
| 7.5: Skilled for 2026 | 92 |
| 8: The Regulatory Environment | 100 |
| 9: Industry Knowledge Priorities | 106 |
| <hr/> | |
| Bibliography | 112 |
| Appendices | |
| Appendix One - CSIRO | 118 |
| Appendix Two - VCI | 122 |
| Appendix Three - AMMA | 132 |
| Glossary | 134 |



**QUT – Cube Building –
Institute for Future
Environments.**

METS Ignited has its national headquarters within Queensland University of Technology (QUT) in Brisbane – a multidisciplinary pioneer research institute and education and community hub for STEM.

METS Ignited also has established a node in Melbourne with an additional node planned for Perth.



1

Executive Summary

Executive Summary

The Mining Equipment, Technology and Services (METS) sector in Australia is very diverse. It is comprised of firms that provide specialised products and solutions for mineral exploration, extraction and mining supply chains. This includes equipment manufacturers, engineering services, mine software products and other related equipment, services and technologies where the primary function of the division, department or specialty firm is to support the mining and mineral extraction industries. METS companies by definition derive the majority, or a significant proportion, of their revenue from products and services supplied to the mining sector and, as a consequence, there is a mutually beneficial relationship between the METS and mining sectors. METS companies focus on developing solutions and providing services to mining companies, both domestically and globally. They are innovative and have a deserved reputation for the development of cutting edge technologies. The partnership of both METS and mining companies with publicly funded research organisations (PFRs) has resulted in world class outcomes, which have been deployed not only within the mining industry, but also in adjacent industries including the defence, automotive and manufacturing sectors.

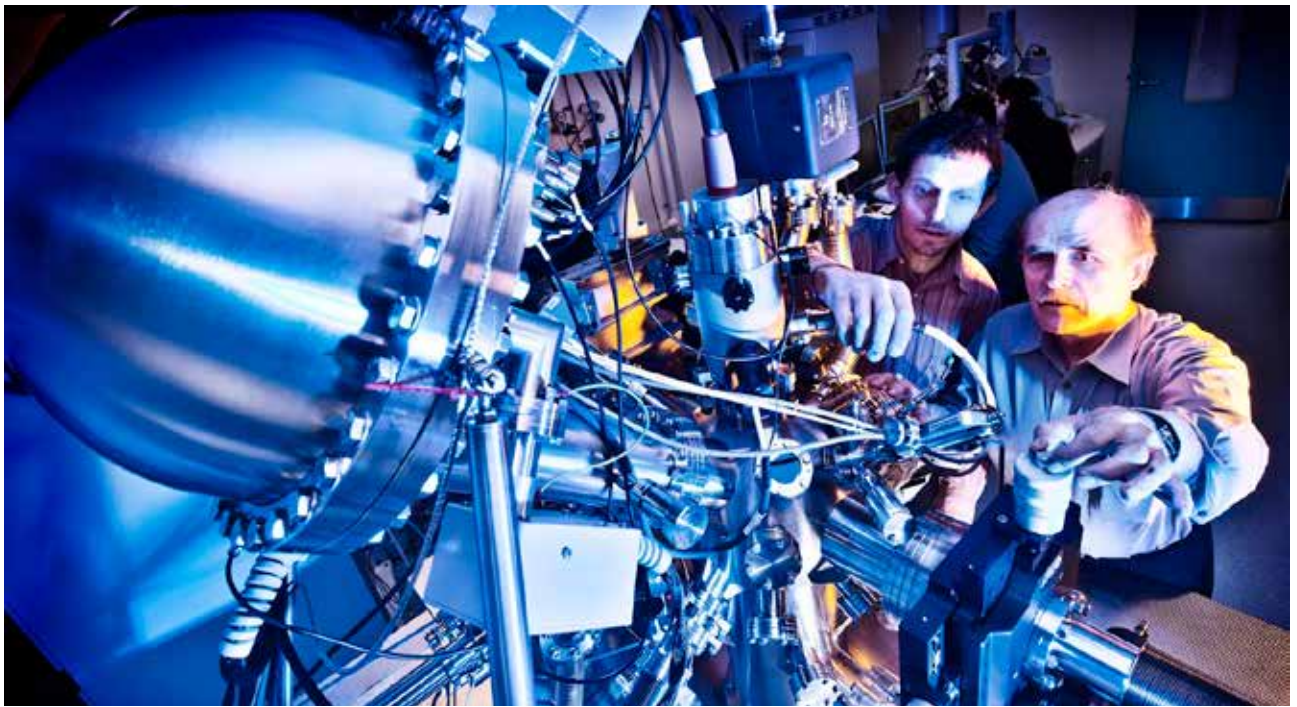
The interdependence of the METS sector, mining, research and government is recognised in this Sector Competitiveness Plan (SCP). The METS sector cannot thrive unless mining thrives and neither will realise their full potential without the engagement and support of research and government.

"METS companies, by definition, derive the majority, or a significant proportion, of their revenue from products and services supplied to the mining sector."

The SCP has been developed after extensive research and consultation with industry. In-depth research into the trends impacting and shaping the future of the mining and METS sectors was undertaken by VCI and supplemented by CSIRO. A national consultation process, designed to test the research findings with industry was conducted from late April until early June 2016. During this process, consultations were held across six states with over 400 sector participants. Twelve public consultations were held, attended mainly by METS SMEs, but also included representatives from the mining sector, PFRs and from state and federal governments. The public consultations were supplemented by a series of roundtable consultations and in-depth interviews with more than 50 c-suite executives from both the larger METS and mining organisations.



Jan Bowe, Principal Consultant, Bendelta; METS Ignited Chair Elizabeth Lewis-Gray and Chris Gibbs-Stewart, CEO Austmine capturing industry input during the SCP consultation process in Adelaide.



*The research and consultative process highlighted the significant advances that the METS sector has made in recent years and its many strengths and opportunities. It did, however, also focus on the sectoral weaknesses and the threats to future growth and prosperity. **Specifically, the consultation process explored five broad themes:***

- The impact of the rapidly **growing METS sectors in developing economies**, like India and China, and the opportunities and threats this posed for the Australian METS sector, both domestically and internationally, as it seeks to expand its global supply chain participation. More broadly, the strategies that would be critical in stimulating enhanced global supply chain participation.
- The **importance of social licence** in ensuring that the mining and METS sectors have a sustainable base in Australia from which to grow. Specifically, the opportunity for METS to take a leadership role in changing the image of both sectors, and the Australian community's perception of the contribution that they make to the economy and our standard of living.
- The **changing face of technology** and the opportunity to embrace it in the way we work. Specifically, the **application of new technologies** to the future profile and archetypes of mining. The sector's readiness to embrace emerging digital technologies, big data, the Internet of Things and automation was assessed and a range of technical knowledge and research priorities were debated.
- The need to **accelerate the rate and pace of innovation** and specifically to enhance the current track record of commercialising our innovations. This sparked debate about the current barriers to improvement and highlighted the need to significantly enhance the level and quality of collaboration within and between the METS, mining and research sectors. It highlighted the need to establish platforms for driving collaboration and to identify initiatives that would drive systemic change.
- The **quality of relationships** in an ecosystem characterised by the interdependence of the METS, mining and research sectors. Specifically, the behaviours that characterise relationships currently and those that would be required to develop a relationship that is seen by all as mutually beneficial.

The need to change is compelling; Australian Mines and Metals Association reports that mining productivity levels are at record lows, down 43% from their peak¹, although a recent recovery is evident. Given this, miners need to urgently and consistently lower overall operating costs, increase exploration success, improve mining and mineral processing capabilities in lower class assets and enhance their social licence with the community. The METS and research sectors are well placed to assist mining companies to deliver the services and innovative solutions necessary to achieve these strides.

There is however a need to improve relationships and there is evidence, in other sectors and other geographies, that if there is a commitment, shared vision and a concerted program of work, relationships can become not only mutually interdependent but also mutually beneficial.

Call to Action

Despite the success of the Australian METS industry to date, a number of key challenges and ecosystem trends are threatening its ability to compete and grow in the global market place



Relationships between miners and METS are largely transactional and **not strategic**, leaving much value "on the table," thereby putting Australia at a disadvantage when compared to other more collaborative competitor regions such as Scandinavia where key clusters of miners and METS work together across the value chain² (VCI, State of Play)



The Australian capital markets lack depth - especially in early stage and long-term capital – and combined with weak management skills (Roy Green), limit growth in business scale



Australia has not been successful at **transferring public sector research into commercial outcomes**, despite having some of the **strongest mining related research** institutions in the world³ (CSIRO)



Despite the number of major Australian mining houses and world class R&D infrastructure, **few Australian METS have emerged as major global OEMs**, inhibiting access to global supply chains of the T1 miners



Disruptive technologies, such as digital, are both a threat and an opportunity and their impact is accelerating at an exponential rate



Australia is ranked **poorly** (33rd and declining) **on collaboration** - a critical innovation measure⁴ (OECD)



Competition from new and emerging markets such as China and India

¹ Menalda, Tristan. (June 2016) "Economic Trends for Mining and METS." Australian Mines and Metals Association

² CSIRO Futures. (May 2016) "Australia 2030 – Navigating Our Uncertain Future."

³ ibid

⁴ Parker, R. Cox, S and Senyard, J. (June 2015) "Options for Developing a Sustainable METS Sector Part 2: Business Models."



METS Ignited Chief Executive Officer Ric Gros speaks with industry members during the Adelaide SCP consultation workshop in April 2016

On the basis of the research and the consultations a draft SCP was developed in June 2016. It was socialised extensively in July and August 2016 with key opinion shapers in the METS and mining sectors and with senior representatives from PFROs and governments.

This revised version of the SCP has benefited from a wide range of views and perspectives. Whilst views on some issues vary, there is unanimous agreement that notwithstanding the METS sector's achievements to date, there is a significant opportunity to grow its size, impact and participation in domestic and global supply chains. Further, it is generally accepted that developing the level and quality of collaboration and strengthening the relationships between Australian METS, mining companies and researchers will be key to accelerating the sector's growth and success. In the face of increasing global competition, it is critical that the sector's competitiveness is strengthened and sustained.

Developing the level and quality of collaboration and strengthening the relationships between Australian METS, mining companies and researchers will be key to accelerating the sector's growth and success.

The SCP builds on this understanding through its five programs of work – highly interdependent and mutually reinforcing

1. Align the strategies and roadmaps of METS, miners and research institutions, ensuring innovation is characterized by customer-pull rather than product-push.
2. Develop a stronger sense of identity in and for the Australian METS sector – through the development of a clear brand and value proposition.
3. Accelerate the participation of the Australian METS sector in domestic and global supply chains by fostering clustering and collaboration; and by increasing the level of engagement with and investment by capital markets, so that funding for both innovation and company growth can be accessed.
4. Establish platforms, virtual and physical, where METS, mining companies and researchers can come together to solve problems, develop solutions and implement them as partners.
5. Support the METS sector with a skilling program to strengthen entrepreneurial and collaboration capabilities and to ensure the sector's strong technical skills are continuously updated in the face of rapidly evolving technical and mining trends.

SCP Programs of Work



**Aligned
Strategy**



**Collaborative
& Innovative**



**Skilled for
2026**



**Global
Brand**



**Internationally
Competitive**

Each of these five programs has a small number of initiatives associated with it. It is intended that as the SCP is reviewed annually, these initiatives will be reviewed and refreshed.

The 2016 SCP includes a preliminary assessment of the regulatory challenges facing the sector and it is anticipated that these will be the subject of more detailed analysis in the 2017 SCP. Concerns were raised about the burden imposed by lack of harmonisation of OH&S rules and practices at a site by site, company by company and state by state level, through the consultative process. That said, the focus by participants on the regulatory burden on the sector, in general, was comparatively subdued.

An important component of the SCP process has been the identification of the knowledge priorities for the sector. With a clear focus on the goals we aspire to, the knowledge and skills gaps have been identified and codified into Industry Knowledge Priorities. There is however, still a body of work to complete with sector participants to refine them.

Realising the goals of the SCP will depend on the support of a wide range of organisations and individuals from the METS, mining, PFRO and government sectors. Indeed, it is recognised that many of the initiatives identified in the SCP will build upon and add impetus to work that is already underway. Much of this work has been stimulated by Austmine, the Minerals Council of Australia (MCA), and CSIRO, and supported by a range of other associations and government departments, at both a state and a federal level. The SCP recognises and builds on this work.

Whilst METS Ignited will lead a small number of initiatives across the five programs of work, importantly they will play a lead role in working across the sectors, to identify organisations and individuals keen to lead and or champion specific initiatives.






METS Ignited sees its role as a catalyst to:

- bring together the numerous initiatives already underway into a coordinated program of work
- galvanise the needed resources to give initiatives the weight of influence required
- use its influence to bring key thought leaders from across METS, mining, research and government together to champion, drive and role model change within their sectors and across the sectors
- work with the key industry bodies, including Austmine, AusIMM and MCA, to give weight to the many related initiatives they already have underway to these ends.

"Realising the goals of the SCP will depend on the support of a wide range of organisations and individuals from the METS, mining, PFRO and government sectors."



Alignment of the SCP's Programs of Work with the Growth Centre Objectives

| |  Aligned Strategy |  Global Brand |  Internationally Competitive |  Collaborative & Innovative |  Skilled for 2026 |
|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Improving management capabilities & workforce skills | | | | | ✓ |
| Improving the capability of sectors to engage with international markets and global supply chains | | ✓ | ✓ | | |
| Enhancing industry research collaboration and commercialisation | ✓ | | | ✓ | |
| Identifying opportunities for regulatory reform | A preliminary review of the opportunities for regulatory reform was undertaken for this SCP and is included at page 102. A more detailed exploration will be undertaken in 2016/17 | | | | |



*Australia's geological discovery
and research is world class.*



2

*The METS
Industry in
Australia*

The METS Industry in Australia

In 2012/13, at the peak of the resources cycle and when commodity prices were at record highs, METS companies were estimated to have generated some \$90bn in gross revenue and employed an estimated 386,000 people. This period of prosperity resulted in significant sectoral growth for both METS and mining companies, and was characterised by a focus on building capacity and optimising production.

However, despite or perhaps because of the “boom/bust” character of the resources sector— time was not taken at the top of the cycle for mining and METS companies to work together and invest in future focused innovation. As a consequence, post the boom the sector has gone through an extremely difficult period and with a focus on survival and resultant resizing of the industry, the economic impact has been significant.

The Australian mining sector urgently requires new sources of productivity, to consistently lower the costs of production; to find and leverage new ore bodies and new mining techniques; and to significantly enhance its social licence with the community. Collaboration with the METS and the research sectors can deliver the services and solutions necessary to achieve these strides. Failure to innovate or to work collaboratively will not only undermine the sector’s ability to evolve and improve the cost curve, but will jeopardise a significant underpinning of the Australian economy and put Australia at risk of being left behind and missing out on the next boom of opportunities.

Taking a long term view, there appears good reason to be optimistic about the METS sector’s growth and prosperity. Commodity prices are returning to more sustainable levels, and new technologies, including the Internet of Things and digitisation provide a base for a new wave of innovation and productivity improvement. As an outcome of its cyclical nature, the sector is resilient and has learned a propensity for adaptation; harnessing this and accelerating the innovation cycle will be key to future growth.

“Australian METS companies can be optimistic given their considerable natural advantages. They operate within one of the largest and most advanced mining sectors in the world, they are close to Asia - which is retaking its place at the centre of global economics - and have access to a highly educated, diverse and innovative workforce. Other countries recognise the Australian brand as one of high standards that is clean, safe and well supported by regulation and policy frameworks which are stable and advanced.”⁵

Whilst many Australian METS companies have been in operation for decades, recognition of the industry as a distinct sector - by participants, by customers and by the broader Australian community – is still developing. Like the mining sector, the METS sector has been a significant contributor to the Australian economy. The Australian METS industry derives significant benefit from having a strong and internationally competitive incumbent mining industry. Indeed, as Austmine reported in 2014;

“As a mining nation, Australian METS have benefited from the opportunity to work closely with domestic mining houses, and this relationship has become a source of competitive advantage which, in turn, has been leveraged to produce highly unique, customer focused solutions.”⁶

In profiling the diversity and structure of the METS sector, the Minerals Council of Australia commented that, there are three broad segments. The service segment is the largest and ranges from the provision of exploration to contract mining services. The second largest segment is focused on equipment provision for mine development, mining and processing. The third segment – which is growing rapidly, is focused on the provision of highly specialised technology – equipment, software and related services.

⁵ Stanway, Graeme (May 2016) “METS and Mining: A 20 year Horizon”. VCI

⁶ Austmine (2014) “Australian METS Global Leadership Opportunity”

The 2013 and 2015 surveys of the sector by industry association, Austmine, provide a snapshot of the sector's diversity and impact:^{7 8}

\$90bn
Gross revenue at peak

At the peak of the resources cycle (FY12) METS companies generated some \$90bn in gross revenue and employed an estimated 386,000 people (FY12). The Australian METS sector has contracted in recent years, again reflecting the interdependence it has on the mining sector globally.

METS companies can be found all across Australia with capital cities, regional areas and remote locations benefiting from revenue, jobs and exports 80% of the Australian METS sector are locally owned.



METS export some \$15 billion in products and services to over 200 countries and territories.

66% Exporters in the sector

25%
Annual revenue from export activity



Within the Australian METS sector 66% are exporters and on average reported 25% of their total annual revenue is derived from export activity (2015).

Globally focused & highly creative

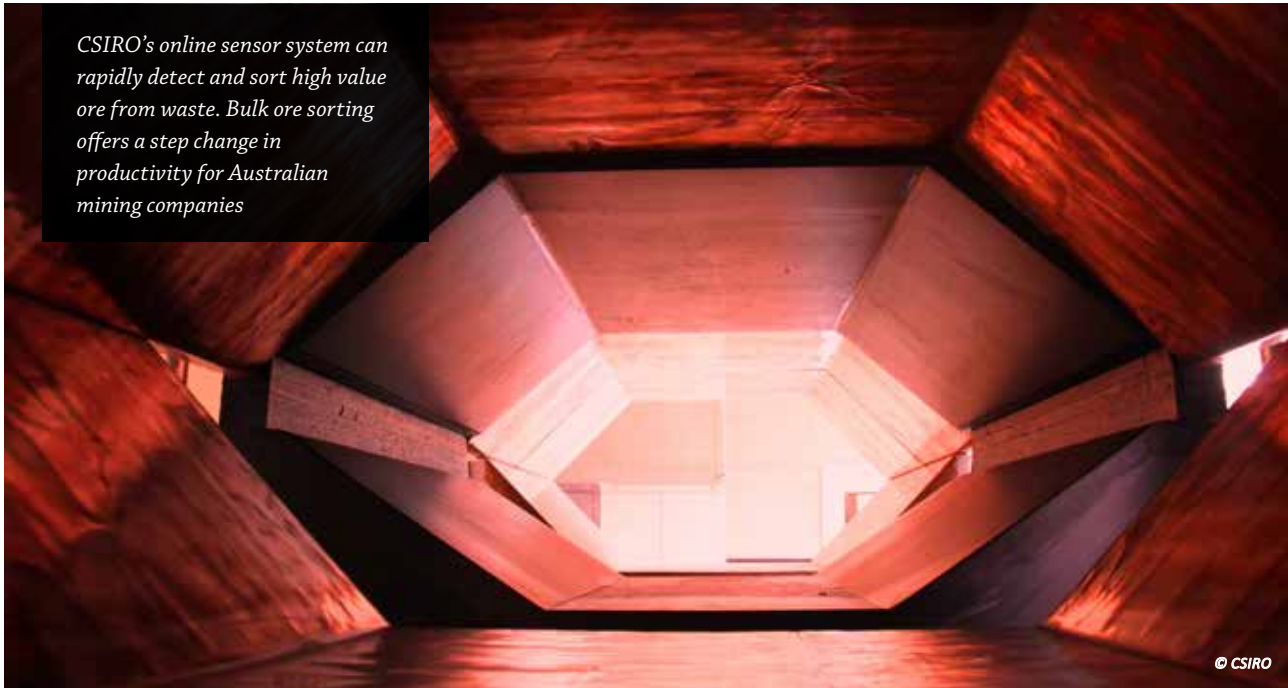


The METS sector is powered by highly creative, globally focused manufacturing firms (41% of the sector's value).

⁷ Austmine (July 2013) "Australia's New Driver for Growth, Mining Equipment, Technology and Services"

⁸ Austmine (June 2015) "New realities, Bigger Horizons. Australian Mining, Equipment, Technology and Services (METS) National Survey"

CSIRO's online sensor system can rapidly detect and sort high value ore from waste. Bulk ore sorting offers a step change in productivity for Australian mining companies



The Australian METS market is characterised by a high proportion of local SMEs (albeit at the larger end of the SME scale), a few large local METS companies and strong participation from global OEMs.

“Multinational firms are major providers of certain services. For example, companies such as Bechtel and Fluor capture a major share of large EPCM contracts, though Australian firms like Ausenco, Sedgman and Worley Parsons are winning EPCM contracts against leading international firms.Multinational firms such as Caterpillar, Komatsu and Metso dominate the supply of core mining and processing equipment.”⁹

The commoditised nature of mining has meant that mining companies have a heavy reliance on METS companies for innovation across all aspects of their value chain and on PFROs for research into new technologies and applications. Despite their size, Australian METS companies are globally recognised for their technological innovation, and their services and solutions have underpinned the sustained growth and competitiveness over time of the Australian mining sector.

As noted by Austrade, not only are Australian METS firms competitive across the entire mining supply chain, there are notable areas of global excellence.

“Australian geologists have developed sophisticated and technologically advanced systems that enable them to explore and develop mineral deposits worldwide at minimal cost, and this expertise is in great demand internationally.”

“Australia's dominance in mine development has led to specific areas of expertise including geotechnical consultants, hydro and resource geologists, mining, civil, mechanical, electrical and process engineers, metallurgists, environmental scientists and experts in the fields of project feasibility, risk assessment, financing and project management.”

“Australia is a world leader in software that services the resource industry, with 60 per cent of the world's mining computer software being developed in Australia.”¹⁰

Further as VCI has observed,

“The METS industry lead the way in applying advanced geo-mechanics and fracturing techniques, small bore tunneling technology and solvent extraction approaches.”¹¹

Whilst the Australian METS sector has a deservedly high reputation for the quality of its innovation, like Australian industry generally, it has a poor track record when it comes to commercialising these innovations.

“While Australia is internationally recognised for its strong research and development institutes we rate poorly amongst our major competitors when it comes to converting this work into commercial success. In 2015, global rankings of innovation such as those by Cornell, INSEAD and WIPO ranked Australia 72nd out of 141 countries for “innovation efficiency” (i.e. the ratio of innovation output (e.g. commercial outcomes) to innovation input (e.g. R&D spending))”¹²

Australia's poor record for the commercialisation of innovation is evident in the METS sector and seems to be correlated with a comparatively low level of collaboration through the innovation process which results in a lack of alignment between problems and solutions. Notwithstanding the interdependence of the METS, mining and research sectors, relationships are often characterised as transactional rather than strategic.

9 Scott-Kemis, Don, (March 2013) “How about those METS? Leveraging Australia's Mining Equipment, Technology and Services Sector”. Minerals Council of Australia.

10 Austrade, “Mining Equipment, Technology and Services” <https://www.austrade.gov.au/.../Mining-Equipment-Technology-and-Services-ICR.pdf>

12 Cornell University, INSEAD and WIPO (2015). The Global Innovation Index 2015: Effective Innovation Policies for Development, Fountainbleau, Ithaca, and Geneva

11 Stanway, Graeme (May 2016) “METS and Mining: A 20 year Horizon”. VCI

Whilst the Australian METS sector has a deservedly high reputation for the quality of its innovation, it has a poor track record when it comes to commercialising these innovations.

In the 2016 Innovation State of Play Report, the relationship between mining companies and their suppliers was,

“...Highlighted frequently by (mining) CEOs as the most important factor, however, their assessment of the current state of this relationship was seldom positive.”¹³

METS innovation as a consequence, often takes place in isolation, and there are reportedly, systemic barriers to METS companies accessing mining customers to either co-design, or test and prototype early in the development phase.

Indeed, METS companies report having limited, if any, access to the strategies and roadmaps of mining companies and as a consequence develop their products and solutions without a clear understanding of and involvement by the customer. METS companies find it challenging to gain access to live test sites where they can prove up and refine their innovations and to establish the ROI for their products and services. Without active engagement of the customer and the research community from ideation, through design and prototyping, the likelihood of innovations finding a realisable market will remain low.

The asymmetrical nature of the mining and METS sectors in Australia (relatively few large mining companies with significant buying power; a large number of SME METS companies with relatively low market influence; the monopolisation of relationships with T1 miners by relatively few, very large and global OEMs) explains to some extent the evolution of these relationships.

Generally speaking relationships are optimised for local SMEs when they are dealing with T3 mining companies – who by definition are local, comparatively small and highly dependent on contracted support. In contrast T1 mining companies are large, global and looking for standardised solutions across geographic borders and across mineral types – large OEMs, large engineering firms and contract miners have successfully intermediated these relationships and the local METS SMEs struggle for access.

As a consequence of their size, Australian METS SMEs are clustering to gain the scale necessary to meet the needs of the larger Australian based mining companies and to compete efficiently in global markets. There is scope for a significant increase in METS clustering, as Port Jackson Partners found;

“Australia is well on the way to creating an internationally competitive commodity support cluster covering a large range of skill sets. If this emerging cluster is encouraged, the potential economic benefit to Australia from future global demand for natural resources will be magnified.”¹⁴

Whilst there is an appetite amongst METS sector participants to grow their level of participation in global supply chains, there are a number of challenges that need to be overcome at both an industry and a company level, including scale, access to capital, concerns about IP protection and the industry’s comparatively low brand recognition.

“The industry’s low visibility is a key factor in the inability of firms to gain contracts in major projects. Australian heavy engineering firms are not well known among global developers who, as a result, rely on their global supply chains for products and services. The use of Australian participation plans, marketing industry capability aggressively and promoting networks of small firms are key to overcoming this problem.”¹⁵

“If this emerging cluster is encouraged, the potential economic benefit to Australia from future global demand for natural resources will be magnified.”

Barriers to Innovation



¹³ Stanway, G. Mahoney, P. Griebel, C. Stickell, M and Lilly, P. (2016) “Innovation State of Play – CEO Insights, Mining.” VCI, EMI and UWA.

¹⁴ Port Jackson Partners (August 2011) “Earth, Wind and Fire: Economic Opportunities and the Australian Commodities Cycle.” ANZ Insight

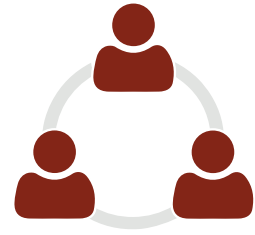
¹⁵ Australian Department of Industry, Science and Resources. (May 2011) “Backing Global Competitiveness: Government Response |to the Heavy Engineering and Infrastructure Action Agenda”.

Immersive Technologies is a global leader in mining simulation, learning systems and data analytics in the resources industry. In addition to exporting to 40 countries they also have exclusive development and partnering alliances with global OEMs such as Caterpillar, Komatsu, Hitachi and Liebherr.

The SCP consultations identified that the large majority of Australian METS companies are SMEs and are not well connected to the global mining supply chain. This reflects common industry structure where T1 miners prefer to deal with global OEMs so as to standardise practices across global operations.



Consultations with the METS sector in 2015 and 2016 highlighted a number of very consistent themes and reinforced the importance of collaboration to accelerating the sector's growth and prosperity.



2015 Consultations

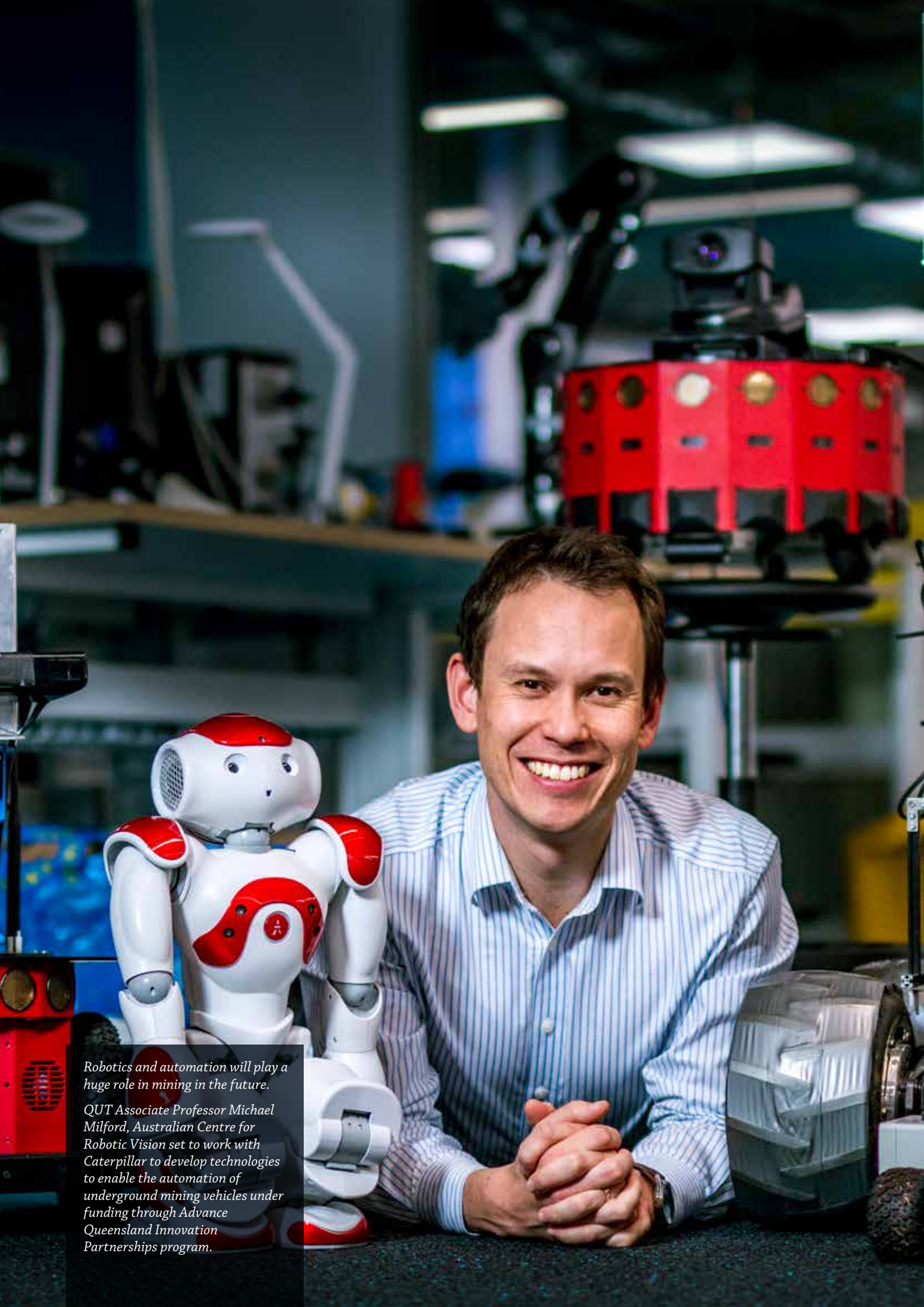
The productivity and competitiveness of the sector is impeded by:

- restrictive procurement processes by major miners
- reluctance by miners to trial or adopt new innovations that disrupt current operations
- difficulty in accessing senior level decision makers and understanding current needs (problem identification) and long term technology roadmaps of miners
- cost of engaging with large miners too high for SMEs
- cyclical nature of industry limits sustainable growth and development of scale
- lack of management and skills capability in areas such as finance, sales, marketing and global strategy
- limited access to finance - both early stage and patient capital
- non-harmonisation of state based (and company based) regulations imposes costs on supplier and miners impeding productivity.

2016 Consultations

Accelerating the productivity and competitiveness of the sector is dependent upon:

- establishing platforms/mechanisms for collaboration between METS, miners and researchers: design thinking is a potential lever for collaboration
- early stage collaboration which is critical to increasing the rates of innovation and commercialisation: and specifically opportunities to co-design, trial and test innovations in-situ (Living Labs)
- relationships between METS and mining companies becoming significantly more collaborative and strategic
- an aligned vision and goals for the ecosystem participants (METS, mining, research and government)
- alternate pathways into mining companies being developed to allow METS companies to showcase innovations (other than through procurement)
- a compelling METS brand that resonates domestically and globally, and positions Australian METS to capitalise on the opportunities and withstand the challenges arising out of the growing Indian and Chinese METS industries
- market research to understand target markets and evolving customer needs
- mechanisms to support cluster development which facilitates scale based competition particularly in global supply chains
- increased participation and investment by capital markets to underpin growth
- investment in skill development, specifically in leadership and management, commercial, sales and marketing, and relationship skills to successfully grow.



Robotics and automation will play a huge role in mining in the future.

QUT Associate Professor Michael Milford, Australian Centre for Robotic Vision set to work with Caterpillar to develop technologies to enable the automation of underground mining vehicles under funding through Advance Queensland Innovation Partnerships program.



3

The Changing Face of Mining

The Changing Face of Mining

The mining sector in Australia is, and has long been, a major contributor to the Australian economy. In the 2000s the Australian resources sector expanded significantly in response to a growth in the global demand for commodities, mainly fueled by growth in China. Indeed, as KPMG indicated between 2004 and 2008, Australian mining exports doubled, largely to the Asian region.

"Whilst mining investment, which boomed between 2004 and 2014, fueled by the growth in China has flattened in recent years, mining production which really took off in 2007 continues today."¹⁶



¹⁶ KPMG. (12 March 2015) "Workplace Relations and the Competitiveness of the Australian Resources Sector." Australian Mines and Metals Association

¹⁷ BIS Schrapnel (2014) "The New Mining Boom in Australia"



Notwithstanding the continuing strength of mining production the Australian Mines and Metals Association¹⁷ report that resource companies are under significant pressure to rethink and reshape business models and operating procedures in response to:

- *Suppressed commodity prices which is putting greater attention on cost management and ultimately margins.*
- *Mining multifactor productivity levels trending at record lows, down 43% from its peak.*
- *Ageing mines, with reserves depleting and falling ore grades.*
- *A trifecta of leading indicators for future supply issues (critically low exploration; declining tier one discoveries; and major projects being scrapped or put on hold) has elevated the importance to increasing mining recovery rates.*
- *Greater perceived and actual social licence to operate obligations.*
- *Significant landmass left unexplored, under-explored with outdated technologies.”¹⁸*

Whilst the Australian mining sector is universally regarded as having a vibrant future, there is no argument that if we look out over a 20 year-horizon, the face and practice of mining will be fundamentally different than it is in 2016.

VCI, a specialist consulting company to the resources industry, has observed that

“Fundamental advances in computing power, artificial intelligence, automation, robotics and biotechnology are creating new opportunities across the resources industry.”¹⁹

“Fundamental advances in computing power, artificial intelligence, automation, robotics and biotechnology are creating new opportunities across the resources industry.”

¹⁸ Menalda, Tristan. (June 2016) “Economic Trends for Mining and METS.” Australian Mines and Metals Association

¹⁹ Stanway, Graeme (May 2016) “METS and Mining: A 20 year Horizon”. VCI

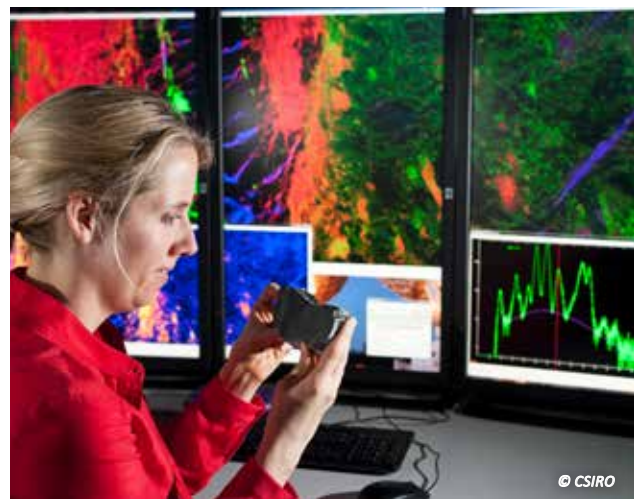
Looking out to 2036, VCI²⁰ saw the following trends having a significant impact on the world of mining:

- **Global economic development** and the rising middle class in developing countries like India and China fueling demand for minerals and mining products.
- **The drive for new ore bodies underground and underwater** to meet this demand in the face of fewer high quality near-surface ore bodies.
- **Globalisation** will be a continuing trend with the emergence of new mining regions as advanced technologies change the economic viability of mining in currently underdeveloped regions.
- **Business Models** will be challenged in the face of increased globalisation and technological advances – there will be an increasing trend towards specialisation and niche plays whilst significant opportunities will accrue for those organisations willing to collaborate and cluster to optimise potential along the value chain.
- **Societal expectations** driving an increasing focus on environmental impacts, rehabilitation and sustainable practices; increasing levels of activism and a heightened expectation of information transparency.
- **Automation and data analytics** which will change the economics and productivity of mine operations, impact monitoring and the technical efficiency of mine equipment.
- **Increased computing power** will facilitate hyper connectivity of people, technology and systems, will support data capture, data analytics and advanced diagnostics, but will underscore the demand for integrated systems and interoperability.
- **Technology advances** in computing, robotics, construction and engines will not only change extraction methods and economics but will have consequential impacts on demand for specialty industrial minerals and rare earths.

- Technology advances will also change the **employment profile of the industry**, with an increasing trend to unmanned equipment, smart tracking, and robotics.
- **Modularisation** will hold the design key for enabling the rapid upgrading and maintenance of equipment in highly integrated, continuous systems.
- **Advanced exploration techniques** will dramatically change the economics of drilling, increasing its accuracy and effectiveness by an order of magnitude and as a consequence the proportion of economic underground mines.
- **Global energy** will be impacted by the drive to solar energy, battery storage and smart distribution grids in place of traditional fossil fuels like coal.

In summary, VCI postulated,

“In 2036, all mining equipment will be autonomous and controlled as part of an integrated value chain system which will be optimised using artificial intelligence on a market pull basis, creating highly responsive production systems. Integration with preferred customers and suppliers will become seamless. Maintenance that isn’t automated will be undertaken by staff assisted by augmented reality technology. Robots and drones will be cheap and ubiquitous and will carry out ad hoc physical tasks with zero risk to people.”²¹



²⁰ Ibid

²¹ Ibid

VCI has developed **five broad contextual areas** in which the **key METS industry drivers** can be placed. Within each bucket, we have developed an initial list of specific drivers to be researched, analysed and debated with METS Ignited.



Economic

- Chinese economic transition
- Global convergence of China and India with western economies
- Ageing population and global public debt
- Interconnectivity of global economies
- Transition to knowledge economy, trans-national hubs and US influence
- Globalisation of work and relativity of wages



Social

- Increasing social expectations of mining companies
- Increasing transparency, everything is local
- The changing nature of work
- Increasing focus on health and wellness
- Older, wealthier populations



Technology

- Digitisation, ubiquitous sensors, automation, robotics
- Low impact, ore only mining
- Exploration visibility at depth (+1,500m)
- Ubiquitous knowledge, transparency
- Increasing interoperability of equipment, software



Industry

- Increasing move towards underground mining
- Cyclical stages of the industry will continue
- Energy supply side shift
- Modularisation of equipment, preference for mining agnostic
- Agility and goal of hyper-efficiency



Business Model

- Specialisation along and integration of value chains
- Age of big data and data driven business models
- Open marketplace for work
- Exploration technology disrupts 'venture value chain'
- Service driven business models
- Financial markets can 'trade everything'





Australia's capabilities in its mining policy, infrastructure and community, safety, human resource management and environmental policies are recognised globally. Countries with developing and growing mining industries have taken advantage of Australia's government and private sector expertise in these fields to inform their own mining industry and mining project development. Clusters of government agencies, research groups and METS companies have provided their skills and experience in mining and environmental policy, safety, social licence and indigenous relations to developing international mining projects, supported by Australia's strong, positive branding.

Similarly CSIRO²² has identified **6 key trends** that they see impacting the future of mining.

1

Plugged In and Switched On

Digital technologies, data analytics and automation along with greater mobility and increasing connectivity is creating exciting opportunities for the mining industry. These connected technologies are accelerating safety and productivity and driving disruptions across the mining value chain and life cycle.

4

The Knowledge Economy

Developing countries are emerging as key suppliers of mined resources globally. However, many lack the trained staff required for efficient and sustainable exploitation of mineral reserves. This presents a new market opportunity for developed countries to export their advanced knowledge, skills, expertise and technology.

2

The Era of Accountability

Mining companies are expected to be good corporate citizens, meeting public expectations regarding accountability and environmental and sustainability considerations. Earning and maintaining community support for mining projects will be imperative for risk management over the next twenty years

5

The Innovation Imperative

Falling commodity prices, declining ore grades, decreasing productivity and rising costs are compelling the mining industry to focus on innovation. Companies require new solutions and technologies to become more productive, less water and energy intensive, more sustainable and ultimately more profitable.

3

New Supply, New Demand

Increasing urbanisation and rapid development of emerging economies will continue to raise demand for mineral resources – demand which will be met by supply from developing nations. Rapid adoption of new technologies are forcing nations to consider future strategic needs, particularly looking at high-value, low-volume metals and minerals.

6

Rethinking our Reserves

Rates of discovery for high-quality and accessible ores are declining and not keeping up with depletion leading to the need for continued exploration and solutions that extend the life of a mine through more effective processing of low grade ore bodies. At the same time, greater social expectations are leading to a rise in recycling and discussions of our urban (or above ground) mining reserves.

Irrespective of the lens used there is broad agreement about the trends that will shape the future of the mining industry, globally and in Australia. VCI²³ has hypothesised five possible mining archetypes that will evolve in response to these trends:

- The Intelligent Resource Factory
- Finding, Defining and Planning
- Platforms and Modularity
- Small Footprint Extraction
- Nothing and Unknown

²² CSIRO Futures (May 2016) "Australia 2030 – Navigating our Uncertain Future"

²³ Stanway, Graeme (May 2016) "METS and Mining: A 20 year Horizon". VCI



Anna Littleboy, Research Director, Mineral Resources Flagship, CSIRO, speaking at the Queensland University of Technology 'Mining and Energy in 2025 and beyond' Symposium about global megatrends and their implications for the resources sector.



4

The Role of Research

The Role of Research

The recently released report of the inquiry into Australia's Future in Research and Innovation found that Australia has world leading universities and research organisations that can lay claim to significant contributions to new knowledge and technological and scientific innovation.

*"Australia accounts for 3.71 per cent of the world's publications and 6.9 per cent of the world's one per cent most highly cited publications."*²⁴

We have some of the strongest mining related research institutions in the world.²⁵ The research sector supporting the mining and METS sectors includes CSIRO, Data 61, CRC Mining, CRC ORE, CRC DET and a multitude of universities with mining related faculties - UQ, QUT, UNSW, UTS, RMIT, UWA, Curtin, Newcastle University, Federation University, University of SA, and University of Wollongong. It also includes facilitative institutions like AMIRA, ACARP, ARC and MRIWA. Both the mining and METS sectors benefit from the strength and diversity of our research sector and there are many examples of productive interaction between these sectors and PFROs.

However, the recent decline in commodity prices has resulted in a decline in both corporate exploration budgets and research investment. Further it has raised the hurdles for research projects - putting the focus on the short-term returns (typically 18-24 months), on research with immediately implementable results; and has reduced the appetite for pure research.

Notwithstanding the strength of our research sector, Australia's track record in commercialising our investment in research could be improved. In comparison with other OECD countries Australia has a strong research sector and performs well during the initial stages of the innovation system. Australia performs relatively poorly, however, in university/business collaboration and in commercialising research and innovation.

Universities Australia found that;

*"The percentage of innovative firms in the manufacturing and services sectors that undertake R&D, either internally or with a partner, is the lowest and second lowest respectively in the OECD. In addition, only 9.3 per cent of large firms in Australia (27 of 28 OECD countries) and 9.2 per cent of SMEs (21 of 28) introduced products new to the market in the period 2010 to 2012."*²⁶



²⁴ Joint Select Committee on Trade and Investment Growth, (May 2016) "Inquiry into Australia's Future in Research and Innovation" Commonwealth of Australia

²⁵ CSIRO Futures, "Australia 2030 – Navigating Our Uncertain Future." May 2016.

²⁶ Universities Australia (February 2016) "Submission to the Review of the R&D Tax Incentive"

“The Growth Centres will work to unlock commercial opportunities and drive innovation by building links between businesses and industry organisations and the science and research sector.”²⁸

As a consequence:

“In 2015, (in global rankings of innovation such as those by Cornell, INSEAD and WIPO) Australia ranked 10th for Innovation Input but 24th for Innovation Output. Australia was ranked 72nd (out of 141 countries) for Innovation Efficiency, or the ability to translate inputs into outputs.”²⁷

The opportunity for improvement is clear and is central to the establishment of the Growth Centre Initiative by the Federal Government. As reported by DIIS:

“The Growth Centres will work to unlock commercial opportunities and drive innovation by building links between businesses and industry organisations and the science and research sector.”²⁸

Across all industry sectors, enhanced collaboration between industry and research has been identified as critical in innovation being accelerated and commercialised. DIIS in its submission to the “Inquiry into Australia’s Future in Research and Innovation” commented that:

“Links between research organisations and businesses are crucial in order to diffuse knowledge and commercialise research. Research collaboration is also fundamental to scientific excellence and technological breakthroughs.”²⁹

There is a good base of collaboration from which to build:

“Mining and METS go hand in hand...according to 81% of companies, working closely with customers is how competitive advantage is maintained. The direct coupling has become a source of innovation which, in turn, has been leveraged to produce highly unique, customer focused solutions. When benchmarked against other industries, the METS sector has a strong innovation culture. Importantly as well, METS companies invest. They invest in their customers, in their staff, in their products and in their future.”³⁰

Indeed, the 2015 Austmine survey reported that 39% of METS respondents collaborate with other organisations on R&D projects.³¹ Similarly there is evidence of healthy collaboration between METS and miners. Australian METS SMEs, given their size and scale have been most effective in their collaboration with T2 and T3 mining companies. This collaboration has been mutually beneficial and has been instrumental in the small and mid-tier mining companies innovating and prospering by bringing in critical expertise and accessing innovative solutions as and when they have needed them. T1 miners on the other hand have looked to global OEMs in the main for collaboration and strategic relationships. For both the T1 miners and the OEMs their scale and global footprint makes this a logical partnering.

Both METS and miners work with researchers around the country though there is scope to improve the point in the innovation process at which the collaboration begins, and specifically to better facilitate the access of SMEs to research partners. Similarly, there is scope to review the levers and metrics that influence our research institutions, to ensure that they support a greater level of commercialisation. As CSIRO reported:

“...Australia’s innovation dilemma - the systemic issue of translating innovation inputs into economic, environmental and social outcomes for industry. While Australia is internationally recognised for its strong research and development institutes we rate poorly amongst our major competitors when it comes to converting this work into commercial success.”³²



METS Ignited Chair Elizabeth Lewis-Gray and Jon Lorraine, Chair of CRC ORE, sign a Memorandum of Understanding to work together.

²⁷ Cornell University, INSEAD and WIPO (2015). The Global Innovation Index 2015: Effective Innovation Policies for Development, Fountainbleau, Ithaca, and Geneva

²⁸ Department of Industry, Innovation and Science (January 2016) “Industry Growth Centre Initiative”²⁹

²⁹ Joint Select Committee on Trade and Investment Growth, (May 2016) “Inquiry into Australia’s Future in Research and Innovation” Commonwealth of Australia

³⁰ Austmine, (July 2013) “Australia’s New Driver for Growth, Mining Equipment, Technology and Services”.

³¹ Austmine (June 2015) “New realities, Bigger Horizons. Australian Mining. Equipment, Technology and Services (METS) National Survey

³² CSIRO. (January 2016) “Tomorrow’s Digitally Enabled Workforce: Megatrends and scenarios for jobs and employment in Australia over the coming twenty years.”





5

The Challenges Facing the Sector

The Challenges Facing the METS Sector

After a period of incredibly strong growth, the METS sector is working with a mining sector challenged by its economic context. This includes:

- low prices in the majority of commodities
- comparatively high exchange rates
- tighter margins
- limited cash flow
- high and increasing production and operating costs
- lower grades and higher strip ratios and waste removal costs
- deeper deposits requiring increased pre-production expenditure and the subsequent higher mining and extraction costs.

At the same time there is increasing global competition, with both mine development and METS sector growth in emerging economies where the cost of production is significantly lower than in Australia. Compounding the challenge are new technologies that are expected to drive significant change to business models and value propositions. The challenge for the Australian METS sector is that, without a significant increase in innovation and commercialisation, which fundamentally increases productivity and accelerates comparative advantage, accelerated growth and prosperity for both mining and METS will be difficult to achieve. Failure to innovate and to accelerate commercialisation across both sectors not only undermines their ability to evolve and improve the cost curve, but it jeopardises a significant underpinning of the Australian economy.

The need to change is compelling; the Australian Mines and Metals Association reports that mining productivity levels are at record lows, down 43% from their peak.³³ Given this, miners need to urgently and consistently lower overall operating costs; increase exploration success; improve mining and mineral processing capabilities in lower class assets; and enhance their social licence with the community. The METS and the research sectors are well placed to assist mining companies to deliver the services and innovative solutions necessary to achieve these strides.



³³ Menalda, Tristan. (June 2016) "Economic Trends for Mining and METS." Australian Mines and Metals Association

There is, however, a need to improve relationships and there is evidence, in other sectors and other geographies, that if there is a commitment, shared vision and a concerted program of work, relationships can become not only mutually interdependent but also mutually beneficial. The importance of collaborative relationships is well understood,

*"It is important to note that few organisations can pursue all the activities necessary to develop and commercialise any innovation on their own. Rather organisations innovate through interactions and connections within their innovation ecosystems to access critical skills and capabilities – a process which needs to be managed effectively to result in successful innovation."*³⁴

Despite the acknowledged importance of collaboration, examples of collaboration early in the innovation process and consistently thereafter are comparatively few.

Whilst strategic collaboration does occur between the sectors, the lack of systematic strategic collaboration is a significant reason that so much of the METS sector's innovation has not been commercialised. METS companies find it challenging to find a market for the solutions they have developed, and often take the view that mining companies are risk averse or have a low level of interest in innovation or indeed any solutions that will impact their core operating systems. Mining companies argue, in response, that far from being risk averse, it is not commercially feasible to implement solutions that have not been appropriately tested and debugged. Co-design is critical to overcoming these misaligned perceptions.

Another key challenge to innovation, commercialisation and supply chain penetration, relates to the sector's access to capital. The DIIS in its submission to the Joint Committee on Trade and Investment Growth, commented:³⁵

"Almost a third of innovative Australian businesses have identified a lack of access to additional funds as their biggest barrier to innovation. Innovation-active small and medium sized enterprises are also much more likely to seek debt or equity finance compared to their non-innovation-active counterparts."

In its submission to the same Joint Committee, DFAT identified:³⁶

"...access to finance [as] a key constraint to business-led innovation,' particularly for small to medium sized enterprises (SMEs). Unfortunately, SMEs often had poor or no credit ratings and were often without 'the resilience that diversification affords larger enterprises and... the depth of resources to withstand a downturn."

DIIS has also reported that:³⁷

"Australia has the 'lowest proportion of venture capital invested in high-risk, early-stage venture capital (i.e. seed, start-up and other early-stage investment) compared with other OECD countries.' While investments are most numerous in start-up and early expansion stages, the bulk of investment is in late expansion and turnaround stages."

"Failure to innovate and to accelerate commercialisation across both sectors not only undermines their ability to evolve and improve the cost curve, but it jeopardises a significant underpinning of the Australian economy."

³⁴ University of Melbourne and Centre for Workplace Leadership. (2016) "Leadership at Work: Do Australian Leaders have what it takes? Study of Australian Leadership."

³⁵ Joint Select Committee on Trade and Investment Growth, (May 2016) "Inquiry into Australia's Future in Research and Innovation" Commonwealth of Australia

³⁶ *ibid*

³⁷ *ibid*

The current economic context and the need to shift the dial on relationships dominated the feedback on the sector in the 2016 consultation program. Through discussions with more than 400 individuals across the METS, mining and research sectors, a consistent view was presented of the sector's challenges.

The consistent themes included:

- The desire for a cohesive vision and set of common goals for the sector.
- The benefit that would accrue from the development of a sector brand – for use both domestically and globally.
- Increased sharing between sector participants of strategic plans and roadmaps.
- The need for greatly enhanced collaboration:
 - ↳ shifting relationships between METS, miners and researchers to a much more strategic partnering level
 - ↳ the development of platforms and mechanisms for collaboration between sector participants; design thinking is seen as a potential lever for collaboration.
- Removing the systemic barriers to innovation including:
 - ↳ the need to improve the access that local METS SMEs have to decision makers in the larger mining companies. Specifically, finding alternate pathways to the procurement departments to showcase innovative solutions
 - ↳ the slow transfer of IP, particularly from PFROs
 - ↳ new models for IP management, including alternate perspectives on the recognition and valuing of IP
 - ↳ an appreciation that with the current low level of commercialisation, the IP being so keenly protected was often valueless
 - ↳ greater IP protection for Australian companies entering global markets and particularly those countries focused on low cost, fast follower strategies.
 - ↳ increasing the access of METS companies to “Living Labs” to trial, test and demonstrate their innovations in-situ. This is seen as key to overcoming the reticence of mining customers when presented with unproven solutions.
- Strategies to overcome scale issues which hamper enhanced participation in supply chains:
 - ↳ opportunities for Australian METS SMEs to partner with Global OEMs in areas of specialisation, again facilitating access to work with T1 mining companies, locally and globally
 - ↳ development of infrastructure to support METS clustering, thereby overcoming scale challenges and enhancing the ability of companies to deliver more integrated solutions
 - ↳ increasing the understanding and investment of capital markets in the METS sector. This will be key to METS SMEs achieving the scale necessary to increase their participation in the global supply chain.
- Strategies to ensure the sustained capability of METS SMEs to compete in a fast evolving competitive context:
 - ↳ support for the METS sector to understand and prepare for the emerging technical landscape, specifically the impacts of digitalisation/big data and the Internet of Things
 - ↳ the need for METS companies to counterbalance their strong technical expertise with enhanced commercial, sales and marketing and relationship skills
 - ↳ an increase in the participation and deployment of graduates and postgraduates across the sector. This will necessitate enhancing the attraction of the sector to students and graduates and developing and promoting an understanding of possible career paths
 - ↳ increasing the social licence enjoyed by both mining and METS, by overcoming the community's negative perceptions regarding environmental impacts and sustainability
 - ↳ harmonising and simplifying the regulatory framework the sector operates within
 - ↳ this includes, but is not limited to, overcoming the state-to-state inconsistencies in OH&S regulation which imposes a significant cost burden on the sector.

Australia has significant strength and a global footprint in drilling and related services with a number of leading METS companies active in this area. This capability is supplemented by Australia's world-class consultancies, software services and innovative technologies in the mining geo-technical and drilling space. The CRC for Deep Exploration Technologies (DET) is based in Adelaide and is developing improved technologies and processes for deep drilling and exploration under cover.





Universities and research partners play a pivotal role in helping METS companies act upon opportunities in the industry. Australia's mining research sector is considered to be amongst the best in the world. Close alignment of universities researchers and industry will support the growth of the sector in Australia and globally.



6

The Opportunity for the Sector

The Opportunity for the Sector

Australia is well placed to play a dominant role in the mining industry of the future. Innovation in business models, technologies, behaviours and relationships will be required to facilitate this. As previously canvassed, the face of mining in 2026 will be significantly different to 2016. This, in turn, indicates that there will be significant transformation in the world of METS and the role of research and how they interact with each other and the global mining industry.

Success will depend on:

- METS, mining and research industries collaborating more effectively with each other and earlier in the innovation process to develop tomorrow's solutions
- METS companies, and specifically SMEs, clustering together to achieve scale, to accelerate technical change and to optimise value chain opportunities
- METS companies aligning their focus to the strategies and roadmaps of mining companies
- METS companies accessing Living Labs where they can prove up and refine their innovations and to establish the ROI for their products and services
- active engagement of the customer in the innovation process from ideation, through design, prototyping and testing
- overcoming the challenges that SMEs currently experience in finding suitable research partners and financing collaborations with universities
- growing Australia's comparatively small capital market participation and increasing the market's level of investment in the METS sector.

The importance of collaborative relationships is well understood by mining companies, METS SMEs and the research fraternity. There is however, a need to further evolve relationships across the sectors and there is evidence, in other sectors and other geographies, that if there is a commitment, shared vision and a concerted program of work, relationships can become not only mutually interdependent but also mutually beneficial.

Whilst the history and economic underpinnings are markedly different to those in Australia, the growth and relative strength of the METS sector in the Scandinavian countries represent a positive case study of what is possible. The METS sector in Sweden is underpinned by:

- clustering of METS companies
- a strong network of Research and Technology Organisations (RTOs)
- integrated sector plans – METS, mining and research
- Design Thinking – which puts the customer at the centre of all design and innovation and engages their input from the beginning and throughout the development cycle
- significant government investment, cluster activity support and organisational funding.³⁸

Indeed, if we look to Scandinavia or to Israel, who are leaders at commercialising innovation, we see strong examples of close collaboration across industry, research and government. Whilst in Europe they refer to it as the triple helix of collaboration, in Australia we need it to be the quadruple helix of collaboration.

³⁸ Forsknings, Gruv. (2016) "Strategic research and Innovation Agenda for the Swedish Mining and Metal Producing Industry (STRIM)." Vinova

Establishing a triple helix of collaboration and innovation

Scandinavia's Triple Helix concept comprises three basic elements.

1. Industry, research and government working together in a knowledge-based economy. In this instance industry has two players - METS and miners.

2. A movement toward collaborative relationships among the three major institutional spheres, in which innovation policy is increasingly an outcome of interaction rather than a prescription from government.

3. In addition to fulfilling their traditional functions, each institutional sphere also "takes the role of the other" performing new roles as well as their traditional function.

In our "quadruple" helix the METS and mining sectors both play a key role in collaborating to create industry innovations.



METS



Mining



Research



Government





Attendees at the Queensland University of Technology 'Mining and Energy in 2025 and beyond' Symposium, examine drone technology.

Unmanned aerial vehicles assist miners in site scoping and mapping, a viable long-term solution to what is often a challenging task in remote locations.

Benefits of new technology such as drones include improved safety, increased productivity, cost-effective and reliability.



7

The METS Sector Competitiveness Plan

The METS Sector Competitiveness Plan

METS Ignited has a vision for the METS sector and its participation in the broader ecosystem,

*"The Australian METS industry has an aligned, efficient and agile industry ecosystem with a high degree of collaboration, global leadership in innovation, and a growing share of the global market."*³⁹

In formulating this vision the METS Ignited Board recognises that the success of the METS sector and the mining sector are strongly correlated.

The growth and competitiveness of the METS sector, domestically and globally, will not be achieved without growth and the improved competitiveness in the Australian mining sector. It follows that the future of the METS sector is best assured when METS and mining companies operate as true partners and both work in tandem with and drive the focus of the research sector.

Critical to success is that there is a shared vision, a shared strategy and shared roadmaps between miners, METS and researchers. Alignment at this level requires mutually respectful relationships, recognition of each party's unique strengths and value add, accelerated IP frameworks, high levels of trust and reciprocity, collaborative working relationships and regular and consistent communication.

If the vision for the METS sector is realised, the result will be:

- an increase in, and an acceleration of, commercialised innovation
- an increase in world leading clusters
- an increase in the participation and investment by capital markets in the sector
- the competitive advantage of the sector more broadly defined and more widely recognised
- an increase in the number of companies exporting and in the quantum of export revenue
- a reduction in import substitutes to the mining sector
- the sustainability of the sector enhanced
- global recognition for the quality of partnering between industry and research.

"Aligned, efficient and agile industry ecosystem with a high degree of collaboration, global leadership in innovation, and a growing share of the global market."

³⁹ METS Ignited (2015) www.metsignited.org.au



The Sector Competitiveness Plan (SCP) builds upon many initiatives stimulated by Governments, Industry Associations, PFRs and METS and mining companies. Many reports, published in recent years, have pointed to the same opportunities, challenges and broad set of needs. Indeed, work has been commenced on many of the initiatives and progress is underway. Much of this work has been stimulated by Austmine and other industry associations, as well as CSIRO and federal and state government departments.

The SCP builds on this work through its five programs of work –
highly interdependent and mutually reinforcing

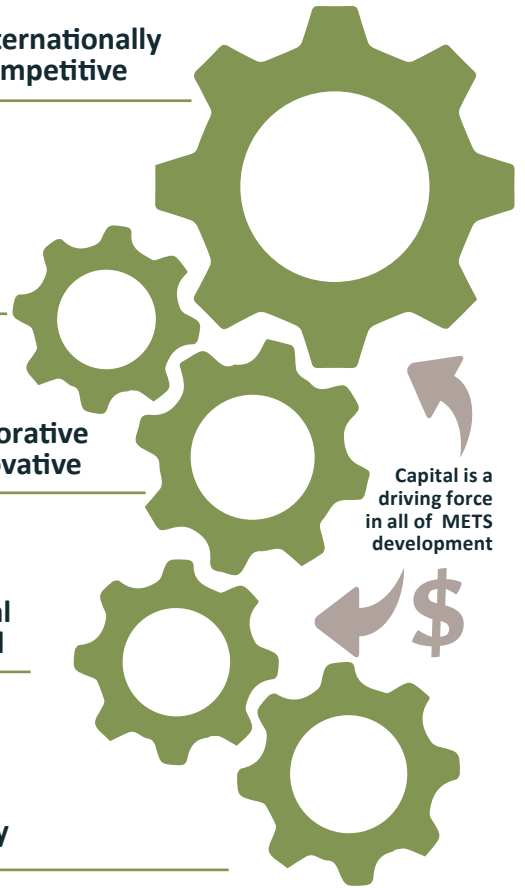
 **Internationally Competitive**

 **Skilled for 2026**

 **Collaborative & Innovative**

 **Global Brand**






 **Aligned Strategy**



Capital is a driving force in all of METS development



The SCP comprises a suite of interdependent programs of work:

| Programs of work | The Vision |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  Aligned Strategy | Working together the METS and mining sectors are better positioned to anticipate trends, to identify opportunities and to de-risk solutions, radically improving productivity, social and environmental outcomes and the growth and competitiveness of both sectors. |
|  Global Brand | An umbrella positioning that has strong resonance domestically and globally and connotes high quality, knowledge intensive solutions; sets standards and expectations and attracts a price premium |
|  Internationally Competitive | Australian METS cluster together to compete effectively in the global supply chain; their growth is enabled by a competitive and supportive capital market. |
|  Collaborative & Innovative | Partnering from the ideation stage; working together to develop and de-risk solutions; live site testing has resulted in a reputation for quality solutions and speed to market. |
|  Skilled for 2026 | Australian METS have, or can access, the full range of skills required to realise their entrepreneurial ambitions. The industry is continually renewing itself. |

The objective of the SCP is to enhance the global competitiveness of the sector and global competitiveness is a function of a broad range of complex factors and generally takes considerable time. Indeed, as McKinsey found, for local companies to achieve global success they need some form of comparative advantage and a solid development plan that plots out a course over 20 years or more.⁴⁰

The SCP, provides the framework for long term development of the METS sector, outlining a focused program of work and carefully targeted initiatives, aimed at positively improving the competitiveness of the sector and the METS industry both domestically and globally.

The effectiveness of the SCP will be measured by:

- growth in the global market share of both the Australian mining (productivity/size/influence) and the METS sector
- a shared vision for the sector and a brand and value proposition for METS that underpins its comparative advantage
- acceleration of the rates of collaboration across the METS, mining and research sectors (leading to 30%+ increases in financial, social and environmental capital)
- the Australian METS sector has a clear and effective brand – domestically and globally.

It is important to note that whilst baseline metrics of competitiveness for the sector have yet to be developed and global benchmarks defined, a suite of key indicators have been identified. It should be noted that assessing and attributing causality definitively is expected to be challenging.

⁴⁰ Dobbs, R. Oppenheim, J. Kendall, A. Thompson, F. Bratt, M and van der Mare, F. (2013) "Reverse the Curse: Maximising the Potential of Resource-Driven Economies." McKinsey Global Institute, December.



The SCP takes a ten-year view over three broad horizons.

2016 – 2019

2020 – 2023

2024 – 2026



Horizon One:
Laying the
Foundations

Horizon Two:
Leveraging our
Opportunities

Horizon Three:
World Class
Innovation Ecosystem

7.1

Program One:
Aligned Strategy





The Challenge

There is potential for greater collaboration between METS, mining companies and researchers. Currently their needs are not always aligned and solutions are not always in sync; innovations are not collaboratively pursued, resulting in implementation risk, low rates of commercialisation and sub-optimal benefit flows.

The Vision

Working together, the METS and mining sectors are better positioned to anticipate trends, to identify opportunities and to de-risk solutions, radically improving productivity, social and environmental outcomes and the growth and competitiveness of both sectors.



Aspiration 1

Bringing the industry together

Australia is recognised for its achievement in developing an integrated METS, mining and research ecosystem.

An effective ecosystem is one that recognises and leverages the relative strengths of the participating communities and optimises their interdependence. Given this, collaboration between Australian METS, mining companies and researchers would be more effective if it was focused on reaching a shared strategic understanding of mine roadmaps, critical business drivers and the application of emerging technologies. Without this focus, METS companies tend to extrapolate needs on the basis of general trends, develop solutions in isolation and then adopt a product-push approach to marketing.

Global best practice reinforces the importance of nurturing and leveraging the interdependence of the mining, METS and research sectors through shared strategies and roadmaps. Indeed, for the Scandinavian countries, there is no distinction between mining and METS sectoral strategies – they are a single blueprint for the future.

Thought leadership is critical to achieving this shift. Engagement of the senior influencers in the sector will be critical given that there is a need to rethink business models and transform relationships.

The SCP envisages:

- forums that bring together key and senior influencers from across the METS and mining sectors to develop and model a collaborative approach to mining
- developing platforms for METS companies to showcase their solutions
- establishing mechanisms to forge and advance relationships between Australian METS companies and global miners.

Aspiration 2

Sharing research & data

The Australian METS industry has recourse to a rich bank of data and research about opportunities and trends, domestically and globally.

The high proportion of SMEs in the METS sector, makes it inevitable that many work in relative isolation and without access to the resources needed to undertake detailed market scans and analyses. Accessing reliable and consistent data about market opportunities to underpin their strategic planning and marketing programs is a challenge facing many operators.

The SCP envisages:

- establishing a repository of data, research and sectoral metrics that is accepted as a base line against which the sector's economic growth can be evaluated
- defining the global opportunities that exist for the Australian METS sector over the next 20 years
- identifying a data platform which can be used to aggregate performance data across the ecosystem
- measuring and reporting the impact of the SCP against agreed indices and benchmarks.

Aspiration 3

A shared vision

The “future of mining” is agreed and well understood and is the strategic basis for planning for both METS and miners.

Currently there are few platforms or mechanisms for strategic collaboration between sector participants. The practice of mining companies sharing their strategies or roadmaps is ad hoc; there are few forums for miners and METS companies to come together to discuss trends, problems or to co-design solutions; there are very few opportunities for METS companies to showcase their solutions and services to mining companies and explore how specific company needs can be best met or accommodated.

Exacerbating this situation, research institutes have comparatively few mechanisms for ensuring strategic alignment. With only two Cooperative Research Centres operating across the mining sector (in comparison with 13 for the Medical Technology and Pharmaceuticals sector) there are few opportunities for industry proponents to come together and problem solve.

The SCP envisages:

- the development of a clear vision for the “future of mining”, building from the work developed by VCI³⁷ and supporting a greater volume of credentialed research into the future of mining
- partnering with PPROs to focus research on agreed technical IKP areas
- encouraging mine operations to embrace a culture of data driven and evidence based decisions
- the compilation of a map/audit of Australian mining related research which can be promoted to help and grow Australian research that informs the sector.



Aspiration 4

Planning the future, together

Technical roadmaps have been developed and align with the “future of mining” METS, mining companies and researchers understand the benefit of co-designing solutions. They recognise the need to work in partnership and to ensure that solutions are tailored to the miners specific needs. To achieve this there needs to be a shared understanding of the strategic plans and technical roadmaps of the mining companies, alignment of research roadmaps and priorities and improved access to mining personnel and decision makers.

Whilst this level of strategic alignment is currently more the exception than the rule, mining companies have a strong appetite for METS companies to focus on those solutions that are core to improved operational performance, cost reduction and productivity improvement. They also recognise that in the absence of a shared understanding of their strategy and

roadmaps, there is significant risk that the solutions of the METS sector, no matter how elegant, will focus on issues that are peripheral to their needs.

The SCP envisages:

- developing an innovation/technology roadmap for the METS sector that reflects the future needs and capabilities required by the mining sector
- platforms being developed that support mining companies to share their strategic roadmaps within the METS sector
- working with PFROs to ensure that their research programs are aligned to the sector's technical roadmaps
- the development of a single portal through which all mining roadmaps can be accessed.



Aspiration 5

Aligning academics & industry

Australian research is strongly aligned to the agreed Industry Knowledge Priorities.

There are a large number of universities and research institutes active in the mining and METS spheres of activity. The majority are well regarded and considered world class. The opportunity going forward is to create tighter alignment between the sectors' needs and their research agendas. Having identified a suite of knowledge priorities for the industry these need to be positioned as the focus for research funding and focus. Specifically there is a need to ensure that collaborative research is closely aligned to and reflects the specific needs and interests of the sector.

The SCP envisages:

- greater alignment between the research activities of ARC and sector CRCs and the agreed Industry Knowledge Priorities
- the development of a research culture focused on consistently delivering results to the industry, and within time frames that support the sector's competitive advantage

In summary, through the consultative process there was a consistent call for METS Ignited to:

- focus on breaking down the barriers to strategic collaboration between mining companies, METS operators and research organisations
 - stimulate platforms for collaborating around needs and problem solving
 - develop forums for METS companies to showcase solutions and services and to open new pathways for METS SMEs to access mining companies
 - foster partnering with research institutions;
 - ensure that the sector's mining, technical and research roadmaps are aligned.
-

Established in 1874, Orica (ASX:ORI) is a Melbourne based mining services company with global operations. Orica is the largest global provider of commercial explosives and innovative blasting systems, a global leader in the provision of ground support, and a leading supplier of sodium cyanide for gold extraction. Orica has a diverse workforce of over 12,000 people servicing customers across more than 100 countries and is one of Australia's METS success stories.





An aligned strategy that recognises the interdependency of the METS, mining and research industries through a strategic framework where there is a shared vision, a shared strategy and shared research and development roadmaps, will deliver the best growth prospects for the overall sector. Supporting this framework with a commitment by sectoral participants to work together as partners will deliver a source of comparative advantage; it will accelerate the deployment of innovation, increase productivity and ensure research is aligned to emerging industry needs and will secure future success.

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| <p>A1</p> <p>Australia is recognised for its achievement in developing an integrated METS, mining and research ecosystem</p> | <p>A strong collaborative ecosystem emerges aligned with the SCP and a shared vision endorses its intent</p> <hr/> <p>Key relationships strengthened, new relationships across the ecosystem are formed, MOUs with well-defined shared initiatives supporting the SCP are the new norm</p> <hr/> <p>Momentum is gained, plans are developed, granularity increases</p> | <p>Promote the findings of the SCP, industry research, consultation and socialisation processes, industry engagement and support for proposed initiatives is achieved</p> <hr/> <p>Launch a thought leadership series engaging senior influencers from mining, METS and research to catalyst the industry’s need for collaboration</p> <hr/> <p>Industry peak bodies are engaged in the ongoing development and refinement of the SCP</p> <hr/> <p>Cross ecosystem SCP initiatives are defined with clarity and ownership</p> <hr/> <p>State governments embrace the SCP and align their development initiatives with the plans intent and objectives</p> | <p>Industry-wide leadership summit is established championing the intent and implementation of SCP initiatives</p> | <p>The SCP review has become a regular industry wide driven and funded initiative.</p> |

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| A2 The Australian METS industry has recourse to a rich bank of data and research about opportunities and trends, domestically and globally | <p>A base line of sectoral research against which to measure the economic growth and other relevant trends of the sector has been established</p> <hr/> <p>The global opportunities for the Australian METS sector over the next 5/10/20 year horizons have been defined</p> | <p>Partner with government and industry and identify a data platform which can be used to aggregate performance data across the ecosystem</p> <hr/> <p>Define the industry data requirements and suitable sources that will underpin effective strategic decision making in the sector</p> | <p>The sector has established a data bank of research and emerging opportunities and is regularly updated</p> | <p>Industry is well versed in leveraging the opportunities identified with the initiatives in the SCP, such as the Global Brand initiative, a vibrant ecosystem, a strong skill base and a highly aligned educational system.</p> |
| A3 The “future of mining” is agreed and well understood and is the strategic basis for planning for both METS and miners | <p>A clear vision for the “future of mining” has been developed</p> <hr/> <p>Credentialed research into the future of mining has been established</p> | <p>A map/audit of Australian mining-related research is compiled, interactive and helps us promote and grow Australian research</p> <hr/> <p>Key industry research such as "Mining State of Play" is supported with global industry engagement</p> | <p>The sector is now actively reviewing updating and fine tuning the future need of mining, identifying more granular and niche opportunities that can provide the Australian sector with global opportunities</p> | |



| Aspirations | Horizon 1 Laying The Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| A4 Technical roadmaps have been developed and align with the “future of mining” | An innovation/ technology roadmap is compiled for the industry which identifies future needs and capabilities | Facilitate access to all sectoral roadmaps through a single interactive portal | Roadmaps are aligned, shared and facilitate effective technology pathways | |
| | Mining companies share their strategic and research roadmaps within the METS sector | Work with mining companies to identify the top 10 grand challenges that are suited to open collaboration and beneficial to METS | | |
| | The emerging and rapid impact of digitisation and the IoT on technological innovation and business models is well appreciated by industry | Pilot industry workshops exploring the opportunities of digitization and the IoT | | |
| | PFROs research programs are aligned to agreed innovation and technology roadmaps | Promote to PFROs the findings of the SCP research, consultation and socialisation. | | |
| A5 Australian research is strongly aligned to the agreed Industry Knowledge Priorities | The research activities of ARC and sector CRCs are strongly aligned to the agreed Industry Knowledge Priorities | With industry develop and publish iteration of IKP iterations | Industry Knowledge priorities are regularly updated | |
| | | Support research into the development and establishment of a METS Business Leadership training centre | | |



Safety glasses

DIEZEL

Energy & Energy in 2025 & Beyond
MONSEN YAHYAE
The University of Queensland
St. Lucia, QLD, 4072
QUT UQ

Session 2: Advances in oil and gas technology

7.2

Program Two: **Global Brand**





The Challenge

Within Australia, awareness of the METS sector, including amongst participants, is still developing. Globally, the Australian METS sector lacks a collective brand promise and positioning, and a proposition that differentiates it from low-cost competitors

The Vision

An Australian METS brand and value proposition which enjoys global recognition, is highly sought and recognised for delivering exceptional value whilst encapsulating safety and sustainability as key pillars. A brand that is supported from cradle to grave, by a network of events that showcase Australian METS capabilities. Domestically the sector's brand is cherished for its contribution to Australian society and for the sustainable solutions it represents; the brand stands for innovation and the application of global, leading edge technology to complex challenges; it is a magnet for attracting new generations of talent to the METS, mining and PFRO sectors.



Global Brand

Aspiration 1

Creating a strong Australian identity in the global market

Globally the Australian METS brand is recognised and respected as a hallmark of innovation and quality products and services.

Globally the lack of a sectoral brand hampers the marketing effort of all METS SMEs as they try to establish their identity and value proposition in the global supply chain. There is significant benefit to be gained if they can underpin their unique offering with the widely recognised attributes and brand promise that attaches to an Australian industry sector. Further, without the cache of a well-accepted brand, the potential price positioning of METS services and solutions in the market is diluted.

METS companies understand the power of representing themselves under an umbrella brand. Indeed, anecdotal evidence indicates that METS companies engaged in exporting are creating some confusion by adopting state-based

branding positions (Victorian METS, NSW METS, etc.) in the absence of an Australian brand anchor. There is a strong call from METS companies to create an Australian brand and value proposition for the sector – one that whilst speaking to their diversity, underpins their offerings with recognition of the innovation and quality of the solutions and draws upon Australia's positioning as clean, green and safe.

The SCP envisages:

- the development of a strategy for a global and compelling METS brand, which leverages Australia's reputation for innovation, quality and environmentally sustainable solutions; is grounded in market research on brand awareness and the desired brand attributes; the development of a value proposition that reinforces the sector's unique strengths

- a brand that leverages and extends Australia's reputation for innovation excellence and the quality of its R&D
- the development of a sector marketing campaign and aligned promotional campaigns to support trade missions and facilitate SME access to global markets
- broadening the understanding of what it is that the sector exports beyond resources to encompass intellectual capital, skills, research, products and services.



Aspiration 2

Driving brand awareness

Domestically the sector is known for the effectiveness of the relationships between METS, miners and research and for the competitiveness and innovation that this delivers.

Recognition of the METS sector is a relatively recent phenomena and given the diversity of the services and solutions it offers, together with its tight linkage to the mining sector, its recognition as a discrete and important industry in its own right has been slow to build. Indeed, amongst the SMEs that dominate the METS sector, there is a high level of variability in terms of whether they see themselves part of METS, as part of the mining industry, or part of the more amorphous services sector. The consultation process highlighted that amongst METS companies there is a low level of understanding of the diversity of the sector generally, and of other METS players even in their local geographic catchment – this inhibits collaboration and clustering.

Mining companies have much to gain from a sectoral brand that counterbalances the generally negative perceptions that communities have of the environmental impacts of mining, with promotion of the knowledge intensive and highly innovative solutions developed within the sector, as well as the size and impact of the sector on the Australian economy.

METS companies and research institutions understand the importance of working with the mining sector to improve the image of mining in society today and understand that the solutions they are developing, particularly in the areas of renewables, remediation, environmental protection and safety have the potential to position the overall sector more positively. They understand that the application of METS solutions to a range of other industry sectors (automotive, aviation, advanced manufacturing, oil and gas) underscores the high utility of these solutions, and as a consequence the very broad contribution that the sector is making to modern Australian life.

The SCP envisages:

- the development of a strategy for an Australian METS brand which is grounded in market research on brand awareness and the desired brand attributes; the development of a value proposition that reinforces the sector's unique strengths
- a partnering program with the mining sector, to improve the image and understanding of mining in Australian society and to raise the profile of METS as a hub for smart solutions and a natural home for entrepreneurial talent
- systematically auditing and promoting examples of METS excellence, as well as collaboration excellence between METS, mining companies and research institutes
- building the social licence enjoyed by the mining and METS sectors as the community develops a greater appreciation of the sector's contributions to the community
- establishing a Minerals Education Alliance to reinforce the excellence of Australian Universities.



Aspiration 3

Developing a major Australian networking event for the METS and mining sector

The sector's brand, its opportunities and the emerging research is consistently promoted, through an international forum such as IMARC.

Many within the mining industry, despite understanding their heavy reliance on the insourcing of services and solutions, think of METS companies as fragmented suppliers rather than as participants in a highly sophisticated and value adding industry. The lack of a sectoral identity that reflects the interdependence of METS, miners and researchers is particularly disadvantageous to smaller METS companies.

"The industry's low visibility is a key factor in the inability of firms to gain contracts in major projects. Australian heavy engineering firms are not well known among global developers who, as a result, rely on their global supply chains for products and services. The use of Australian participation plans, marketing industry capability aggressively and promoting networks of small firms are key to overcoming this problem."⁴²

Australia needs a national forum that positions its mining and METS sectors as global leaders and specifically as the leading mining and METS sectors in the Asian region. Whilst there are currently a number of sectoral conferences, it is critical that Australia develops a

pre-eminent mining conference, one that attracts international interest and is seen by the large global mining companies and OEMs as a key annual event to attend. An Australian event, similar to Canada's annual Prospectors and Developers Association of Canada (PDAC) Convention is the aspiration. Australia's International Mining and Resources Conference (IMARC) offers a potential platform from which this truly global forum can be evolved.

The SCP envisages:

- the promotion of IMARC as a networking conference focused on bringing together government, METS, miners and researchers at an international level to address key opportunities and knowledge priorities
- developing an engagement platform for the mining, METS and research sectors, led by IMARC
- expanding the IMARC franchise beyond a single annual event, to provide a calendar of events throughout the year
- refocusing IMARC in line with agreed Industry Knowledge Priorities for the METS sector.

⁴² Australian Department of Industry, Science and Resources. (May 2001) "Backing global competitiveness: government response to the Heavy Engineering and Infrastructure Action Agenda."





An Australian METS brand and value proposition which enjoys global recognition, is highly sought and recognised for delivering exceptional value whilst encapsulating safety and sustainability as key pillars. A brand that is supported from cradle to grave, by a network of events that showcase Australian METS capabilities.

Domestically the sector’s brand is cherished for its contribution to society and for the sustainable solutions it represents; the brand stands for innovation and the application of global, leading-edge technology to complex challenges; it is a magnet for attracting new generations of talent to the METS, mining and PFRO sectors.

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| B1 Globally the Australian METS brand is recognised and respected as a hallmark of innovation and quality products and services | A value proposition for the Australian METS sector reinforcing unique strengths has been defined | In collaboration with Austmine progress market research into the sources of comparative advantage for the Australian METS sector | A value proposition for the Australian METS sector is established and central to all its communication | Australian METS sector value proposition is recognised globally by the sector. |
| | Market research on brand awareness and desired brand attributes has been completed | Develop a sector marketing campaign to support trade missions and facilitate SME access to global markets and global supply chains | | |
| | A brand strategy for a global METS sector has been developed | Working with Austrade look to leverage the Australian METS sector's reputation as a destination for solving complex problems | | |
| | Leverage Australia’s reputation for innovation, quality and environmentally sustainable solutions | Ensure trade missions are supported by aligned and leveraged promotional campaigns | | |

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| <p>B2</p> <p>Domestically the sector is recognised for its competitiveness, innovation and contribution to the ecosystem and it is a desired career destination for the talent of the future</p> | <p>The METS and mining ecosystem is working with a common front to promote its contribution to Australia’s economic future, its commitment to sustainability and regional development</p> | <p>Develop an industry alliance and a joint voice of communication for the ecosystems contribution to Australia’s ecosystem’s economic future</p> | <p>The ecosystem formalised its approach and developed an industry wide coherent and aligned message that further enhances the work undertaken by individual entities</p> | <p>An industry wide approach to promoting industries contribution is now a standard part of the way in which industry communicates with its stakeholders.</p> |
| | <p>A new generation of talent is attracted to the METS sector and the complex challenges posed by emerging technologies and trends including IoT, digitisation and big data</p> | <p>Develop an industry alliance and a joint voice of communication in support of a talent attraction strategy</p> | | |
| | | <p>Raise the profile of the METS sector as a hub for smart solutions and a natural home for entrepreneurial talent</p> | | |



| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| <p>B3</p> <p>The sector’s brand, its opportunities and the emerging research is consistently promoted, through an international forum such as IMARC.</p> | <p>Australia establishes an annual, globally recognised networking conference bringing together government, METS, miners and researchers at an international level to address key opportunities and industry knowledge priorities</p> | <p>Leverage and support IMARC to grow and establish its reputation globally</p> <hr/> <p>Refocus IMARC in line with agreed Industry Knowledge Priorities for the METS sector</p> <hr/> <p>Leverage IMARC with pre-conference Industry Knowledge Priorities and export focused activities, workshops and papers</p> | <p>The Australian industry has recognised the importance of an annual Australian global networking conference (eg. IMARC)</p> | <p>Australia has an annual conference such as IMARC which is considered a key networking event for the global sector. It is central to all Australian governments promotional initiatives and the hub for leveraging international missions. It brings capital markets, miners, METS research and governments together to celebrate Australia's role on the global stage</p> |
| | <p>Australia’s “latest & leading METS sector innovation” are displayed in a global setting creating a destination of choice for the industry</p> | <p>Leverage and support Austmine’s conference as the global premier METS sector’s innovation conference</p> | <p>The industry recognises Austmine's conference as the global premier METS sector innovation conference and it becomes a central element of the industry's promotional calendar</p> | <p>The Austmine conference is the best-in-class global innovation and technology conference for the METS sector.</p> |



7.3

*Program Three:
Internationally
Competitive*





The Challenge

The global supply chain is dominated by large, foreign owned METS players who “own” the T1 mining market. Australian SMEs are challenged by scale and struggle to access cost competitive capital. They lack the specialist skills required to negotiate new markets and relationships easily.

The Vision

Successful participation in the global supply chain is best ensured through partnering – either partnering with large mining companies to meet their global needs; partnering with large global METS companies to provide niche or specialist services; or clustering with other Australian METS companies to collectively meet demand along the value chain. But, scale is critical and to achieve this, so is access to capital at competitive rates.



Internationally Competitive

Aspiration 1

Creating clusters for success

METS clusters are well developed and are fundamental to global supply chain participation.

Increasing levels of participation in supply chains, whether domestic or global, requires companies to have both sufficient scale and the ability to bring holistic solutions to the table. This means either clustering with other local METS companies or partnering with one of the larger OEMs who have captured the T1 relationships.

Clustering is now a well-established strategy across all industries for stimulating innovation, penetrating new markets and driving profitability. As Michael Porter argued in his seminal work *The Competitive Advantage of Nations*,

“As clusters develop, resources in the economy flow toward them and away from isolated industries that cannot deploy the resources as productively.”⁴³

METS clusters exist currently and represent both a model which can be further leveraged, and an opportunity for research regarding those characteristics that underpin their effectiveness.

“Australia is well on the way to creating an internationally competitive commodity support cluster covering a large range of skill sets. If this emerging cluster is encouraged, the potential economic benefit to Australia from future global demand for natural resources will be magnified.”⁴⁴

Partnering, particularly with large global OEMs offers another avenue for Australian METS SMEs to increase their access to mining companies both in Australia and overseas. Global OEMs dominate the relationships with T1 miners, making it extremely difficult for SMEs to penetrate the supply relationship. The larger miners, interviewed as part of the consultation process, spoke about their need to partner with companies that had a long track record of success; have the size and scale to invest in the relationship; and to provide solutions across geographic borders. The opportunity for SMEs is to look, in the first instance, to partner with a global OEM, providing a niche or specialist service, and building over time their reputation and identity for the services supplied.

The SCP envisages:

- a research program into contemporary industry clusters to identify and then promote learnings through case studies
- identifying and documenting existing clusters in the Australian METS sector
- developing a cluster model for supply chain penetration, domestically and globally
- establishing models/pathways for effective engagement between METS and mining companies that accelerate innovation.

⁴³ Porter, Michael E. (1990) *The Competitive Advantage of Nations*. Macmillan Press, UK

⁴⁴ ANZ Insight. (August 2011) *“Earth, Fire, Wind and Water: Economic Opportunities and the Australian Commodities Cycle.”*



© Copyright 2016 Orica Limited.

Aspiration 2

Accessing global supply chains

SME export participation has been accelerated given their ease of access to the needed knowledge and skills. The Australian METS sector, of all the growth centre sectors, is already highly export focused.

In 2015 Austmine found that 66% of the Australian METS companies it surveyed export their services and solutions – up from 55% in 2013.⁴⁵ Whilst this is a strong base from which to further leverage global supply chain participation, the companies with export experience acknowledge that this has been difficult to establish, slow to build, and is fraught with challenge, particularly when it comes to both protecting and monetising IP.

Concerns about IP protection were expressed throughout the consultative process, including amongst established METS exporters, with companies more frequently citing countries with developing economies, with their emphasis on "fast following" and low-cost production, as the worst offenders.

Successful exporters in the METS sector have focused less on the threats and more on the opportunities that global supply chain participation offers. They identify the following attributes as critical to their export success:

- the ability to leverage global partnerships
- having the scale required to meet export demand
- having access to finance or venture capital to build the scale and fund production increases
- having access to strong marketing and business development skills
- counterbalancing the technical DNA of METS companies with a strong commercial orientation
- accessing mentoring support from successful METS exporters
- support from Austrade and other government agencies and programs supporting exporters.

The SCP envisages:

- fostering the development of communities of practice, which enables peer-to-peer learning and facilitates METS SMEs to more quickly tap into global value chains
- developing opportunities for METS companies to showcase their innovations, solutions and services to the mining sector
- developing upskilling programs for export oriented SMEs (e.g. market entry strategies; cross cultural skills) and researching and promoting the knowledge and skills required for successful international entrepreneurship
- leveraging and influencing government programs that support "export-ready" METS to participate in industry led missions, exhibitions and programs and developing a single platform for METS to access government export support programs.

⁴⁵ Austmine. (June 2015) "New Realities, Bigger Horizons. Australian Mining, Equipment, Technology and Services (METS) National Survey."



Internationally Competitive

Aspiration 3

Growing exports

The rate and value of Australian METS exports has accelerated with the deployment of effective marketing and promotional strategies/campaigns.

Mining is and has long been a global industry and mining deposits continue to be explored and developed across a broad range of countries including newly developing markets. With the decline in commodity prices in recent years, the focus on low-cost production, always at the fore in a commoditised sector, has become accentuated. As a result global mining companies are increasingly looking for standardised solutions that can be implemented across geographic borders and across mineral types.

The emphasis on low-cost production, particularly at this point in the mining cycle, represents a significant challenge to both the mining and METS companies, given the cost imposts inherent in the Australian regulatory framework, the comparatively high Australian wage rates and the rates of company taxation. That said Australia has significant advantages that can be marketed and promoted – the quality of deposits, the quality of technical products and services, Australia's leadership in environmental and safety standards, our political and economic stability, the quality of our research and science, etc.

The SCP envisages:

- leveraging and expanding government programs that support exporters to participate in industry-led missions, exhibitions and programs and raise awareness about Australia's METS sector
- better leveraging IMARC with pre-conference knowledge priorities and export focused activities, workshops and papers
- developing a supportive marketplace for buyers and sellers - speed dating.

Aspiration 4

Encouraging investment

The sector is underpinned by supportive capital markets ensuring the scale needed to participate in global markets.

Whether clustering or partnering, METS companies looking to export generally need an injection of capital to scale up their businesses to meet broad demand. To do this they require access to investment – capital at competitive rates. For many this represents a significant challenge to their business model, as through start up and early growth, the majority are private companies and self-funding. Navigating the capital markets, developing a compelling business plan and a differentiated value proposition requires access to new skill sets – rarely available within the company. At the same time investors and venture capitalists have a low level of understanding about the METS industry and there are significant misconceptions about the risk/return profile of the sector. METS companies with growth and export aspirations need support in accessing the investment market and to educate potential investors on the sector's risk profile.

The SCP envisages:

- promoting Australian METS as an investment sector of choice to the financial and capital markets and creating a network of opportunities for capital providers to meet with and enhance their understanding of METS companies
- establish the METS sector Commercialisation Fund
- stimulating the flow of capital from financial markets to support accelerated commercialisation.





Internationally Competitive

Successful participation in the global supply chain is best ensured through partnering – either partnering with large mining companies to meet their global needs; partnering with large global METS companies to provide niche or specialist services; or clustering with other Australian METS companies to collectively meet demand along the value chain. But scale is critical and to achieve this, so is access to capital at competitive rates.

| Aspirations | Horizon 1 Laying The Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| C1 METS clusters are well developed and are fundamental to global supply chain participation implemented, reflecting contemporary | A strategy to support the evolution of Australian METS clusters is developed and implemented contemporary cluster knowledge and lessons learnt to date | Existing examples of world-class clusters in the Australian METS sector are Identified by region/capability and documented | Industry engagement with clusters has evolved, recognising their importance. Clusters are engaging more formally with the overall ecosystem developing their capabilities and leveraging more effectively what are a range of emerging sectorial initiatives | The Australian ecosystems operate as an integrated entity leveraging all initiatives, recognising the strengths each cluster brings and fostering ongoing collaboration where it benefits and strengthens the industry as a whole |
| | | A cluster model for supply chain penetration, domestically and globally is developed | The sector has actively considered the global supply chain clusters and developed engagement strategies to leverage Australian opportunities | Global engagement is now an intrinsic aspect of the way Australian clusters progress their strategies |
| | | Cluster model for supply chain penetration, domestically and globally, is developed and implemented | Best practice cluster knowledge is leveraged in pilot sites | Regional and Urban clusters in the Australian ecosystem are now seen as leading global examples of what clusters can deliver. |

| Aspirations | Horizon 1 Laying The Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| C2 SME export participation has been accelerated given their ease of access to the needed knowledge and skills | The development of communities of practice – peer-to-peer learning to facilitate METS SMEs more quickly tapping into global value chains is strongly supported | Industry supports and promotes mentoring programs at all levels | Mentoring programs at all levels support access to global supply chains | The sector is now intrinsically interconnected with global supply chains via a deep embedded set of relationships |
| | Opportunities for METS companies to showcase their innovations/solutions/ services to the mining sector are increased and where required developed | Leverage and influence government programs that support “export ready” METS to participate in regional and export missions, exhibitions and programs | Export ready METS are fully aware, engaged and leveraging a broad range of industry/ government missions and international exhibitions behind a strengthening sectorial brand | Industry groups, governments and companies are aligned behind a brand and key set of strategic business development opportunities |
| | Upskilling programs for export oriented SMEs (e.g. market entry strategies; cross cultural skills) are promoted and where required developed | Work with industry to understand the gaps in Australian METS companies ability to promote its innovation solutions and services and develop corresponding strategies | | |
| | The knowledge and skills required for successful international entrepreneurship is researched delivering industry specific MBAs | Support METS sector's aligned research into business leadership and international entrepreneurship | The sector and academia are working closely to gain deep understanding of the educational needs of the sector and collaboratively meet these | Active collaboration between industry and academia are now an intrinsic aspect of the way in which the ecosystem operates. |



**Internationally
Competitive**

| Aspirations | Horizon 1 Laying The Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| C3 The rate and value of Australian METS exports has accelerated with the deployment of effective marketing and promotional strategies/campaigns | Government programs that support exporters to participate in industry led missions, exhibitions and programs are leveraged and where appropriate expanded | Work with DIIS Austrade, State governments and industry to evaluate the opportunities for improving current government programs that support export initiatives | The sector is now intrinsically interconnected with global supply chains via a deep embedded set of relationships, built over time | Industry groups, governments and companies are aligned behind a brand and a key set of strategic business development opportunities |
| | | Leverage IMARC with pre-conference Industry Knowledge Priorities and export focused activities, workshops and papers | | |
| | | Develop a supportive marketplace for buyers and sellers – leveraging models such as speed dating | Active collaboration between industry and academia with the latter now an intrinsic aspect of the way in which the ecosystem operates | The Australian ecosystem leads the world in its ability to engage with miners across all aspects of the life cycle of a project and its ability to introduce proven innovation leads the world. |

| Aspirations | Horizon 1 Laying The Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| C4 The sector is underpinned by supportive capital markets ensuring the scale needed to participate in global markets | The financial and capital markets recognise Australian METS as an investment sector of choice | Leverage IMARC and Austmine conferences as opportunities to promote the sector to capital markets | | |
| | A network of opportunities for capital providers to meet with and strengthen their understanding of METS companies is enhanced and developed where required | Work towards the establishment of a METS Commercialisation Fund | A fund has been established is operating and has already invested in a number of Australian METS opportunities | The Australian METS Commercialisation Fund has built a reputation for supporting the rapid growth of METS businesses |
| | | Stimulate the flow of capital from financial markets to support accelerated commercialisation and the long term capital required to grow scale | | |

7.4

*Program Four:
**Collaborative
and Innovative***





The Challenge

Despite the high rate of innovation, the sector has a poor track record of commercialisation. Collaboration between sector participants can be improved. Concerns about IP ownership impede the potential for value creation.

The Vision

Success depends on accelerating the rates at which we commercialise the innovative solutions we are known for. Working in isolation undermines our potential. Ensuring true collaboration from the ideation stage between METS companies and METS, mining and PFROs will increase application, reduce risk and enhance speed to market. Working together will ensure solutions are targeted at need and are timely; and will support the global shift to standard and open systems.



Collaborative & Innovative

Aspiration 1

Collaborating to commercialise

The collaborative culture in the mining/METS/research sectors is world leading.

Australians have a strong reputation for their ability to innovate and for the quality of their innovation. However, we have a very poor record for the commercialisation of our innovations. The major reason for our low commercialisation rate appears to be our disinclination to collaborate, resulting in a lack of alignment between problems and solutions. Whilst this is a cultural challenge for the country, it has equal application for our mining, METS and research industries. Unless collaboration is accelerated the full potential of the METS sector will not be realised.

The consultation process highlighted:

- the competitive nature of the mining industry which results in relatively low levels of collaboration between mining companies
- the diversity of the METS industry, the predominance of SMEs and the relatively few available networking opportunities which results in comparatively low intra-industry collaboration
- low levels of collaboration between miners, METS and researchers particularly at early stages in the innovation process.

The SCP envisages:

- creating a “think tank” of cross-sectoral thought leaders to sponsor collaboration across the sector
- identifying and promoting current examples of collaboration that is leading practice in the sector
- establishing a community/network that is dedicated to promoting commercialisation of METS innovations
- researching examples of international leading practice in collaborative behaviours and relationships and identifying key attributes of collaborative cultures and sectors.



Aspiration 2**Establishing frameworks for collaboration**

The infrastructure necessary to support and sustain collaboration in the ecosystem is well developed.

Throughout the consultative process the rise of the procurement department in mining companies was cited as a significant inhibitor to the commercialisation of innovation. Understandably procurement departments operate with tight specifications, a strong focus on cost and a low tolerance for non-conforming approaches. They have however, in many instances, become the only pathway for METS companies to bring their solutions to the attention of mining companies. By effectively blocking the access of METS companies to the technical specialists within the mining companies they have further limited the potential for collaboration and co-design. There is a need for an additional and alternate pathway, so that METS companies can meet with technical specialists in mining companies and showcase their innovations early in their development, and foster relationships which result in solution co-design.

The SCP envisages:

- establishing an online platform/ marketplace where miners post challenges and “meet” METS companies with solution capabilities (subject to evaluation)
- establishing a legal framework (from MOU to formal term sheets) and tools to underpin collaboration and partnering
- partnering with Federal and State Governments to establish a single portal for industry and research to access support and resources (funds, people, Living Labs, equipment) to enable enhanced collaboration and accelerated commercialisation
- stimulate an online platform/ marketplace where miners post challenges and “meet” METS companies with solution capabilities (subject to evaluation)
- partner with T1 and T2 mining companies to develop and pilot a model of strategic procurement that facilitates access for METS SMEs to showcase innovative solutions.

Aspiration 3**Stimulating innovation**

The innovation capabilities and the array of innovative ideas in the sector is recognised as gold standard.

The impact of the cyclical or “boom/ bust” character of the mining and METS sectors means that time is rarely taken at the top of the cycle to work together and invest in future focused innovation, or at the bottom of the cycle when risk appetites are low and the focus is on survival. In the mining industry the significant investment in capital infrastructure, the commoditised nature of the industry and the competitiveness of the global market, all mean that there is understandably a low appetite to “bet the resource” on new and untried equipment, processes or systems.

That said, failure to innovate or to take risk not only undermines the mining sector’s ability to evolve and improve the cost curve, but it jeopardises a significant underpinning of the Australian economy. There is a need to systematically explore the barriers to collaboration and commercialisation and to develop systemic solutions.

The SCP envisages:

- researching the barriers to innovation in the Australian METS, mining and research sector
- launching a national METS, mining, research cross-sectoral Design Thinking challenge to stimulate innovation and model collaboration
- supporting the development of new collaborative methods e.g. Hackathons, across the sector to stimulate innovation and encourage a new generation of innovators to the sector
- extending the network of science and technology fairs and extending their appeal with innovators aged five to 85.

Aspiration 4**Accelerating commercialisation**

The rate and quality of Australian innovation is internationally recognised as a benchmark.

METS SMEs, through the consultation process, admitted a reluctance to collaborate for fear of losing their claim on and their ability to fully realise a return on their intellectual property. At the same time there was a strong thread through the dialogue, that the research fraternity similarly focused on control of IP and that this inhibited the potential for partnering. This fear is not unique to METS companies, it is part of the cultural challenge faced by the Australian industry more broadly in accelerating commercialisation. What was not strongly reflected through the commentary, was an appreciation that with the current low level of commercialisation, the IP being so keenly protected was often valueless. There is clearly a need to stimulate a broad conversation about IP, to challenge the current belief systems and to shift the model towards IP licensing. A truly collaborative process will not only improve the rates of commercialisation, but will accelerate speed to market and the potential to capture larger profit pools.

The SCP envisages:

- stimulating the development of a vibrant network of METS Accelerators
- aligning and promoting the value of innovation and investment in the METS/mining sectors to capital markets and developing a comprehensive strategy to accelerate the innovation cycle and time to commercialisation in the METS, mining and research ecosystem.
- in concert with other Industry Growth Centres partnering with PFRs to identify and overcome the barriers to accelerating commercialisation
- researching new models for IP management in a global market and developing and promoting alternate strategies for recognising and rewarding Intellectual Property contributions.



Aspiration 5 Interoperability & the Internet of Things

Australia is recognised as the leader in developing and leveraging interoperability standards.

Collaboration and commercialisation will be further enhanced if the shift to open systems and standard platforms accelerates. The past practice of mining companies developing bespoke systems and platforms made it challenging for METS suppliers to develop applications that were universally compatible. This significantly increased the cost of development, increased risk and lowered the potential return on investment.

The SCP envisages:

- promoting the drive to the Internet of Things
- facilitating the development of interoperability standards
- driving capability development around small data analytics and building the skill base for big data analytics
- leveraging Australia's reputation for test-to-fail conditions to attract global miners and OEMs to concentrate their reliability testing in Australia.

Aspiration 6 Tried & tested

Commercialisation of innovation relevant to the METS/Mining sector is leading practice in terms of time to market, cost of integration and industry take-up.

Many METS SMEs reported working largely in isolation through the development phase and then finding it a challenge to access Living Labs to test their innovations. Whilst they understand that mining companies are looking for "tried" solutions, specifically for solutions that will not put at risk operational performance, they struggle to access avenues to stress test their prototypes in an environment that is of sufficient scale and complexity to satisfy the conditions of a working mine.

Whilst most large mining companies have Living Labs these are not open for general testing.

METS companies recognise that for rates of commercialisation to increase they need to embrace a collaborative approach to solution design from the outset. They need to work in partnership with mining companies to understand their needs, and collaboratively with mining companies and researchers to problem solve and design solutions, build and prototype, test and refine. Whilst a more collaborative process will naturally enable greater access to the Living Labs owned by miners, there is a strong need for independent and open access Living Labs – both physical and virtual – to be established.

The SCP envisages:

- stocktaking and promoting the Living Labs already in operation and available, domestically and globally
- establishing a pilot living lab in Queensland as a basis to test and learn and partnering with a T1 mining company to establish a high profile physical living lab where METS, miners and researchers can demonstrate the

power of collaborating to develop and test concepts and leverage through to commercialisation. This will enable the sector to harvest quick wins and promote these through case studies and research papers

- over time establishing a national network of physical and virtual Living Labs and an associated accreditation standard for them, which provides participants and end users with assurance that the products and services developed have withstood a robust program of testing
- extending the application of Living Labs beyond technical products and services to include new behaviours and workplace cultures.





Collaborative & Innovative

Success depends on accelerating the rates at which we commercialise the innovative solutions we are known for. Working in isolation undermines our potential. Ensuring true collaboration from the ideation stage between METS companies and METS, mining and PFROs will increase application, reduce risk and enhance speed to market. Working together will ensure solutions are targeted at need and are timely; and will support the global shift to standard and open systems.

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| D1 The collaborative culture in the mining/ METS/research sectors is world leading | A “think tank” of cross-sectoral thought leaders to sponsor collaboration across the sector is formalised | A Collaboration Council is established to explore opportunities across the ecosystem | The sector is proactively seeking and establishing collaborative practices and relationships that support the ongoing development of vibrant innovation platforms | The culture of the ecosystem has changed. There are new models, innovation, rapid collaboration, agile adaption and accelerated commercialisation |
| | T1 and T2 miners actively engage with the Australian METS sector creating open collaboration opportunities | T1 and T2 miners develop open collaboration platforms with innovation pathways for METS to engage | | |
| | | Identify T1 and T2 top 10 grand challenges offered for open collaboration initiatives | | |
| | | Partner with T1 and T2 to identify opportunities for improvement at regional level | | |
| | Leading practice collaboration in the sector is identified, showcased and recognised | Launch annual IMARC collaboration award | The sector supports, encourages and rewards leading examples of collaboration | The sector supports, encourages and rewards leading examples of collaboration at individual, company and sector levels. |
| | New collaborative methods e.g. Hackathons, Co Labs, across the sector stimulate innovation and encourage a new generation of innovators | Sponsor and support METS-centric Hackathons, Co Labs and other innovative collaboration initiatives | The sector has developed innovation platforms and pathways that accelerate the ideation lead-time | |

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| D2 The infrastructure and capabilities necessary to support and sustain innovation and collaboration in the ecosystem are well developed | The barriers to innovation in the Australian METS, mining and research sector are understood and strategies developed and implemented to bridge the gaps | Innovation barriers are identified across the ecosystem and initiatives established to eliminate and or diminish impact | Industry is actively implementing strategies that overcome innovation barriers | |
| | An online platform where miners post challenges and “meet” METS companies with solution capabilities is established | Identify and if required establish online collaboration platforms that are sector centric where miners can post challenges and meet METS companies | The sector has embraced beneficial online interaction and is leveraging the emerging collaborative practices, platforms and pathways | |
| | The ecosystem is underpinned by a tool kit that supports rapid collaboration and partnering by companies of varying scale | Showcase industry examples of models of legal frameworks (MOU to formal term sheets) that support accelerated collaboration | Capabilities and tool kits to support accelerated innovation have been identified and: (a) enhanced their promotion where available, (b) developed where not available, and (c) training programs established where required | The industry infrastructure required to support and provide ongoing development of industry capabilities is now regularly reviewed, improved and reformed as required. |
| | Skills and capability tool kits are developed to stimulate innovation and collaboration | Facilitate development of tool kits to support creative innovation workshops | | |
| | An industry portal to facilitate access to all government and industry support is established | Establish a central portal of information of all governments and industry support for collaboration and accelerated commercialisation | | |



**Collaborative
& Innovative**

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| D3 Australia is recognised as the leader in developing and leveraging interoperability standards and related IoT opportunities | <p>The development of interoperability standards is accelerated</p> <hr/> <p>The impact and opportunities created by the Internet of Things (IoT) across the ecosystem are well understood</p> <hr/> <p>The capability development around small data analytics is recognised as providing immediate opportunities for operations today</p> <hr/> <p>Big data analytics and the opportunities it presents are a central element of industry innovation road maps</p> <hr/> <p>A skill base for big data analytics for mining has been developed</p> | <p>Industry supports the rapid development of global Interoperability standards</p> <hr/> <p>Ecosystem is actively collaborating across research and innovation initiatives centred on the IoT</p> <hr/> <p>Ecosystem is actively collaborating across research and innovation opportunities to leverage small data analytics</p> <hr/> <p>Ecosystem is actively collaborating across research and innovation opportunities to leverage big data analytics</p> <hr/> <p>Industry establishes a big data analytics centre of excellence</p> | <p>The sector has played a leading role in the establishment of interoperability standards</p> | <p>The ecosystem has established and is operating centers of excellence with specific focus on leveraging the emerging opportunities from the IoT, small and big data analytics across the sector, and are regularly spinning out successfully commercialised initiatives.</p> |

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| D4 The speed and quality of Australian innovation is internationally recognised as a benchmark | A vibrant network of METS Accelerators is evident | Support and encourage the establishment of METS centric accelerators | METS centric accelerators are common practice | |
| | Promote the value of innovation and investment in the METS/mining sectors to capital markets and the impact on accelerated commercialisation | Promote to capital markets the emergence of a vibrant innovation ecosystem and align to the various initiatives | | |
| | In concert with other Industry Growth Centres partner with the research sector to identify and overcome the barriers to accelerating commercialisation | Establish a cross Growth Centre initiative to identify common barriers to accelerating commercialisation | | |
| D5 Australia is recognised as the leader in developing and leveraging interoperability standards | | Leverage Australia’s reputation for test-to-fail conditions to attract global miners and OEMs to concentrate their reliability testing in Australia | | Australia is recognised globally as the most vibrant location to accelerate the testing and development of product and services in near to and real life applications. |



**Collaborative
& Innovative**

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| D6 Commercialisation of innovation relevant to the METS/Mining sector is leading practice in terms of time to market, cost of integration and industry take-up | A network of Living Labs (e.g. pilot sites) are established, de-risking investment and innovation take-up | Establish a national network of physical and virtual Living Labs | A national network of Living Labs is now documented and operational | |
| | | Establish an accreditation standard for Living Labs, assuring participants and end users of the products and services developed of the veracity and robustness of testing | The standards have evolved and progress becoming standard industry practice | |
| | | Extend the application of Living Labs beyond technical products and services to include new behaviours and workplace cultures | | |
| | T1 and T2 miners work with the ecosystem to establish high profile physical "Living Labs" where METS, miners and researchers can demonstrate the power of collaborating to develop and test concepts and leverage through to commercialisation | Work with T1 and T2 to identify a range of Living Labs | Industry as a whole collaborates to share Living Labs and develop commercial solutions. | |

Participants at various SCP consultation workshops contributed industry insight to early development of the METS Sector Competitiveness Plan.



Transforming Relationships

- Refer #4
- Collaboration - Buyer, Seller case studies - more capable
- Retention of capabilities - Collaborative think tank

- Agree whole heartedly with
(1-5 minute PPT)
- Met the buyer
- Unearthed
- Distance for dev
- Trust into making sections
- Trust within making GM/PMs
- METS Envoys (Team
- es. Kaurin Envoys
- and us low team

7.5

Program Five:
Skilled for 2026





The Challenge

The strong technical orientation of the METS industry is not balanced by the commercial and marketing skills required for effective market penetration and sustained growth. Few are fully equipped to embrace the opportunities of the digital age.

The Vision

Our technical skill base is our strong suit, but monetising it effectively relies on a range of marketing and commercial skills which are relatively scarce currently in the Australian METS sector. Developing the METS skills base to embrace or support access to marketing and sales skills, finance and managerial skills is necessary to support the sector's growth. Technology is rapidly changing and to keep abreast we will need to embrace data, analytics and digitisation – we need to refresh the existing skill base and attract new skills to stay relevant.



**Skilled
for 2026**

Aspiration 1

Identifying skill gaps

The industry's skill needs are well defined and strategies are in place to address them.

The METS sector despite its diversity, has a strong technical orientation and its reputation for the development and deployment of knowledge intensive solutions speaks to the generally high levels of technical sophistication in the sector. This strong technical competence is critical in a METS company's start-up phase, but unless counterbalanced by strong commercial and marketing skills, it hampers company growth and the pursuit of scale.

Through the consultation process METS companies identified a broad range of skills as critical to their future growth and their ability to successfully penetrate global supply chains. Chief amongst these were:

- marketing and sales skills
- business development skills
- business re-engineering skills
- business planning skills
- managerial and leadership skills
- entrepreneurship and innovation skills
- knowledge of finance and capital markets
- stakeholder and relationship management skills
- knowledge of export markets and cross cultural skills.

The SCP envisages:

- partnering with a range of organisation including the Entrepreneurs Program, TAFE/University network to develop programs for METS SMEs in the identified key commercial IKP areas.

Aspiration 2

Education & upskilling

METS are actively engaged in further education to keep knowledge and skills relevant given the changing nature of the sector.

Whilst there are many programs already available in the skill areas identified by the METS sector as critical to their success, the participation by METS operators is comparatively low. Issues of time, cost, and geographic access were identified through the consultation process, as barriers. Factors like relevance and specific application to the METS context were also identified as inhibitors to participation. Research to understand the key barriers will be essential if education providers are to be convinced of the need to revise their offerings to increase the level of METS sector's participation.

The SCP envisages:

- identifying and developing strategies to accelerate the participation of METS participants in further education and upskilling programs
- partnering with education providers to tailor programs and modes of access to the specific needs of the METS sector
- over time promoting an accredited professional development program for METS that supports the establishment of a quality "standard" of knowledge and capability.

Aspiration 3

Demystifying data & digitisation

METS and mining sectors are ahead of the curve on digital disruption and emerging technologies.

METS SMEs recognise that technology trends are changing not only the way that they do business but the business of their customers. Specifically, they refer to the digital wave and the advances in big data and analytics. They recognise the shift to interoperable platforms and the potential of the Internet of Things. However, many admit that beyond an understanding of the concepts, they lack the knowledge of how to embrace and harness these emerging technologies or how to evolve their business models to optimise them.

Whilst for some SMEs there is the capacity to upskill, for others it will be necessary to buy skills in.

SMEs as they grow have to carefully manage their cost base – this limits the ability of some to hire specialist commercial and marketing/business development skills. For these METS companies, having the ability to access specialist contract skills in needed areas as and when they need them is an alternate solution.

The SCP envisages:

- partnering with the ICT industry to develop a program of seminars that demystify big data and digitisation, explaining IoT and interoperability
- partnering with mining companies and universities to develop programs for METS SMEs in concepts like value chain management, the theory of constraints and systems thinking
- raising the profile of METS as a hub for smart solutions and a natural home for entrepreneurial talent.





Skilled for 2026

Aspiration 4

METS mentors

The METS, mining and research sectors work together to create opportunities and to actively mentor their brightest and best.

Competition for STEM graduates is increasing, exacerbated by growing demand from developing economies.

“The number of Asian graduates is soaring, a high proportion of whom are in STEM fields.

They make up 50 per cent of graduates in Singapore, 41 per cent in China and around 34 per cent in South Korea (AiGroup, 2015). As the Australian Government’s White Paper on Australia in the Asian Century acknowledges, one consequence is that Asia has emerged as a global innovation hub (Australian Government, 2012).

Recent descriptions of the Chinese effort to promote its innovative, high-value added industries reveal just how systematically the central, regional and city governments in China are doing exactly what Schmidt has prescribed for Australia. The major regional governments have promoted thousands of science and technology parks in which they encourage western companies to set up

branches. These companies are cajoled into linking up with Chinese universities and enterprises. They are required to transfer their technology, in return for broader access to the Chinese marketplace. In this way university research activities are directly linked to corporate research and productive activities (Breznitz & Murphee, 2011). It follows that Asian countries are becoming quite capable of providing their own services and, more ominously, of providing such services to Australian enterprises and consumers.”⁴⁶

The METS sector’s challenge in attracting and retaining STEM graduates is accentuated in part due to a lack of understanding of the sector itself and the range of business opportunities it encompasses.

Further, the profile of the METS industry is male, Anglo Celtic and ageing - sustainability and indeed renewal will depend on the industry’s ability to attract graduates and women to its ranks. There is clearly a job of work to do in this regard in raising the profile of the sector overall and on improving perceptions of the social acceptability of both METS and mining.

“Ensure a skilled workforce by engaging young people at an early stage and making the sector and attractive career option. Develop the needed technical and managerial skills for today’s workforce and support regional employers to attract talent.”⁴⁷

The SCP envisages:

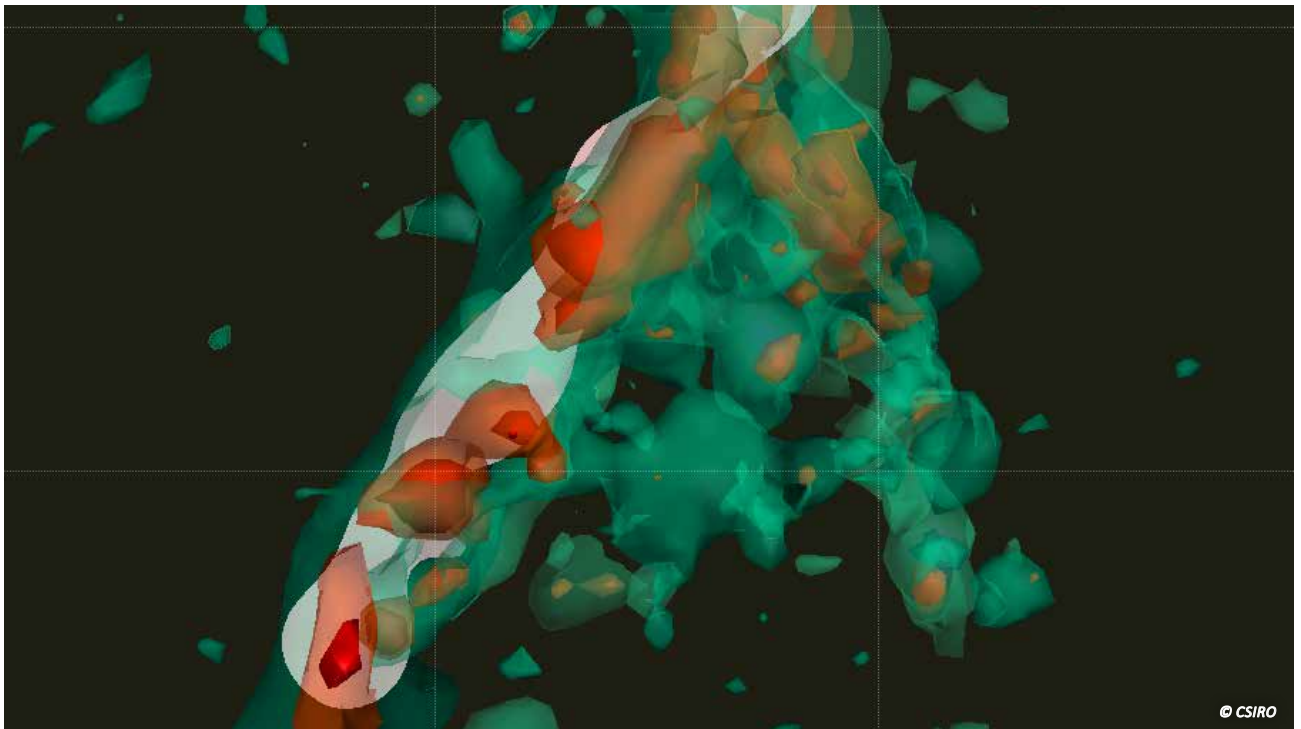
- developing mentoring programs for METS within the broader sector, identifying suitable mentors and developing a mentoring skills program
- developing a profile for a METS sector career
- working with T1 and T2 miners to develop a mentoring program for METS “innovators on the rise”.



© Copyright 2016 Orica Limited.

⁴⁶ Birrell, Bob (September 2015) “Too few or perhaps too many STEM graduates” The Australian Population Research Institute

⁴⁷ Austmine. (July 2013) “Australia’s New Driver for Growth, Mining Equipment, Technology and Services.”



Aspiration 5

Schooling universities in METS

Engagement between METS and the PFRO sector is strong and effective.

Through the consultative process concern was expressed about whether Australia's academic institutions were evolving curricular in line with changing industry needs. There was specific concern about the need to update curricular for mining and metallurgy programs.

"The Australian Federal Government, employers, and accrediting bodies are all calling for more clearly defined 'programme outcomes' or 'exit standards' for tertiary education programmes. The aim of defining these exit standards is to improve:

graduate employability skills;

the quality of tertiary programmes;

the international transferability of graduates and qualifications; and

the marketability of Australia as a provider of high quality tertiary education.

*To do so, tertiary institutions will have to define more clearly what graduates should know and be able to do."*⁴⁸

The SCP envisages:

- working with relevant universities to ensure METS Industry Knowledge Priorities are integrated into degree programs
- working with METS companies to identify and facilitate opportunities for student work experience, internships, research placements and graduate programs
- developing a forum for industry to work with relevant faculties in the university sector to enhance the content of mining/METS related curricular to contemporary industry practice.

⁴⁸ Mining Education Australia (2014) Annual Report.



**Skilled
for 2026**

Our technical skill base is our strong suit, but monetising it effectively relies on a range of marketing and commercial skills which are relatively scarce currently in the Australian METS sector. Developing the METS skills base to embrace or support access to marketing and sales skills, finance and managerial skills is necessary to support the sector’s growth. Technology is rapidly changing and to keep abreast we will need to embrace data, analytics and digitisation – we need to refresh the existing skill base and attract new skills to stay relevant.

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| E1 The industry’s skill needs are well defined and strategies are in place to address them | <p>The sector is well resourced with appropriate skill development programs that are appropriate and accessible</p> <p>The largest skill gaps in the sector – managerial, digital and robotics, have been overcome</p> | <p>Partner with industry, government, Entrepreneurs Program, TAFE/ university and educational networks to develop programs for METS SMEs in key commercial IKP areas.</p> | <p>The sector is now pro actively reviewing its skill requirements and working closely with all relevant stakeholders to maintain relevance between program and courses available and the current and emerging needs of the sector</p> | <p>The sector educational programs and their accessibility to all stakeholders from SMEs to large entities are recognised as leading world practice</p> |
| E2 METS are actively engaged in further education to keep knowledge and skills relevant given the changing nature of the sector | <p>Strategies to accelerate the participation of METS participants in further education and upskilling programs were identified and developed</p> <p>An accredited professional development program for METS that supports the establishment of a quality “standard” of knowledge and capability is established</p> | <p>Partner with education providers to tailor programs and modes of access to the specific needs of the METS sector</p> <p>With industry develop the strategy for establishing a METS accredited capability standards</p> | <p>Active collaboration and engagement by academia and research with METS SMEs and large entities in the sector are now common practice</p> <p>The sector has established a range of METS centered subjects that form cohorts of possible post graduate qualification paths</p> | <p>Active collaboration and engagement with METS SMEs and large entities in the sector are now common practice.</p> |

| Aspirations | Horizon 1 Laying the Foundations | | Horizon 2 Leveraging Opportunities | Horizon 3 World Class Ecosystem |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| | Success Statements | SCP Initiatives | Success Statement | Success Statement |
| E3 METS and mining sectors are ahead of the curve on digital disruption and emerging technologies | A program of seminars highlighting the emerging impact of digitisation, IoT and interoperability provide the sector with a deep understanding of the future | Establish partnerships with ICT industry to develop a program of seminars demystifying big data and digitisation, explaining IoT and interoperability | Industries actively seeks to leverage the centers of excellence that were established with specific focus on exploring the emerging opportunities from the IoT, small and big data analytics across the sector | METS Centers of excellence are now an integral part of the landscape and recognised globally for their contribution to innovation |
| | Programs for METS SMEs were developed to bridge skills gaps in value chain management, Theory of Constraints and System Thinking | Partner with mining companies and universities to develop programs for METS in: Value Chain Management, Theory of Constraint, Systems Thinking | Academia is now delivering appropriate METS centered post graduate programs for METS | Australia is a global leader of METS centered post graduate programs |
| E4 The METS, mining and research sectors work together to create opportunities and to actively mentor their brightest and best | Mentoring programs for METS within the broader sector are supported and enhanced and developed where required | Expand mentoring program initiatives across the ecosystem | Mentoring programs at all levels are emerging as a part of the way the ecosystem operates | The sector is intrinsically interconnected with global supply chains via a deeply embedded set of relationships built over time |
| | A profile for a METS career was developed | Work with industry and academia to define the curriculum requirements for a METS sector career | | The industry has established a range of METS centered subjects that form possible post graduate qualification paths. |
| | Opportunities to gain work experience, internships, research placements, graduate and post graduate programs in METS companies are facilitated | METS and universities work to facilitate processes that provide students with work experience | | |
| E5 Engagement between METS and the PFRO sector is strong and effective | | Develop a forum for industry to work with relevant faculties to align the content of mining/METS related curriculum to industry practice | Working closely with relevant universities to ensure future METS Industry Knowledge Priorities are reflected in degree programs | |





8

The Regulatory Environment

The Regulatory Environment

A key aspect of the work of each Growth Centre is to develop a Regulation Reform Agenda for their designated sector. The objective of this is to contribute to lowering the cost of doing business in the sector, creating a more business friendly environment and ensuring that the focus of businesses in the sector is on growth, competitiveness, productivity and investment.

Whilst not a specific focus for the 2016 consultation process, sector participants spoke to the need for regulatory harmonisation in some areas and reduced regulatory burden in others. They also spoke to the opportunity that exists for government to take a leadership role in establishing frameworks and policy positions in a range of areas, but particularly in relation to supply chain issues. That said, amongst METS operators, regulatory reform generated significantly less debate than the other focus areas of the Growth Centre in both the 2015 and 2016 consultations.

The competitive positioning and comparative advantage of the METS sector will be enhanced by both regulatory change and the development of policy frameworks in areas of emerging focus. The harmonisation of Occupational Health and Safety (OH&S) legislation and practice was the most frequently cited area of need. METS companies work across state boundaries

and spoke to the significant cost burden associated with different state OH&S regimes. This burden is further exacerbated as many mining companies employ different OH&S frameworks and procedures between their sites, resulting in a significant cost impost associated with multiple OH&S induction and reporting requirements.

Similarly, the different rules across states in relation to the legislative framework for senior mine staff, results in significant variation in approaches to risk, appetite for innovation and the preparedness to collaborate.

Whilst Australia has a well-developed framework for the registration and management of IP, the globalisation of markets and trade has highlighted that the different standards and approaches to IP across markets have the potential to undermine Australia's participation in the global supply chain. There is an appetite within the METS sector to explore the potential for harmonisation of IP frameworks internationally or at least across trading blocs.

The opportunity for government to codify and better co-ordinate its support for new initiatives and new business models is an area of interest to the sector. Governments at both a state and a federal level have well-articulated support

"Different standards and approaches to IP across markets have the potential to undermine Australia's participation in the global supply chain."



for growth industries, for enhancing innovation and commercialisation at both a national and an industry level and for stimulating participation in domestic and global supply chains. There is an opportunity to ensure that these activities are better coordinated across government jurisdictions, better promoted to industry and consistently supported by incentives and/or tax breaks.

Significant new trends are emerging, including digitisation, big data, automation, the increasing focus on interoperability, and the growth of the collaborative economy, which are all impacting the way that business is done. The METS industry is looking to government for support, in terms of policy positions and frameworks, to assist them to better navigate these impacts.

The mining industry's social licence to operate has emerged as a significant issue for the entire sector. Community concerns about the impact of mining on the environment threatens the viability and growth of the sector. The METS industry sees the potential for clearer policy and increased harmonisation in relation to environmental practice, site remediation, energy consumption, recycling and renewables.

Accelerating commercialisation in the METS and mining sectors is a key focus for both industry and research. There is a strong desire to shift the dial towards translational research and yet the limited number of CRCs in the sector (2) is seen as an inhibitor. The potential for more active support by government to increase the number of CRCs relevant to the METS and mining sectors will be explored.

Finally, there has been a call from the sector for consistency in terms of government initiative. Specifically, for governments to stay the distance on initiatives like the Industry Growth Centres. The past practice of these types of initiatives being diluted by changes in government or changes in minister were noted as a concern.

The trend to digitisation, big data, automation, the increasing focus on interoperability, and the growth of the collaborative economy are all impacting the way that business is done.

Over the coming 12 months the potential impact of the regulatory environment will be explored in more detail and an action plan developed. Focus will be given to working with sector participants to more broadly define the regulatory framework and the potential for reform of those:

1. Rules and regulations which businesses self-impose and where the cost to the business significantly outstrips the benefit. Deloitte has recently identified a range of examples in the sector:
 - fly-in-fly-out rosters that are ineffective and unproductive
 - no work on fly-in days, regardless of the distance travelled or the mode of transport
 - mines where OH&S managers fill in different reports for each contractor and subcontractors, rather than simply preparing a common report
 - safety gear and safety instructions for people who are only attending meetings in site offices – the same rule applies for an office visit as for a full onsite mine operations visit
 - safety tool box talks required at every shift start, regardless of risk or work area
 - mine sites that grind to a halt when an incident occurs as the medical response team isn't allowed to attend another incident should one occur. This is even required where mines are next to each other and medical teams can be shared.
2. Government regulations that impact negatively on productivity. The Minerals Council of Australia and other industry bodies have identified the following as examples:
 - workplace relations framework and approval process
 - taxation
 - occupational health and safety
 - exploration and mining project approval procedures including environmental approvals
 - tenement administration
 - land access and native title
 - transport including transport infrastructure
 - competition policy
 - vocational and technical education
 - energy levies including diesel fuel imposts

- climate change and the duplication in energy and greenhouse gas emission reporting
- environmental protection
- third party royalties
- planning approvals
- exploration licences and approvals processes.

For the purposes of the analysis, regulation will be broadly defined to include:

“...any rule (endorsed by government or industry) where there is an expectation of compliance. It includes legislation, regulations, quasiregulations, and anything else that can influence or compel specific behaviour by business and the community. It encompasses economy wide regulatory frameworks (e.g. competition policy, tax), international standards and regulatory frameworks, as well as industry specific regulation. Reform opportunities exist not just in removing unnecessary regulation, but in developing best practice regulation.”⁵¹

A broad and detailed analysis is critical particularly in light of Deloitte's recent finding that in the mining industry:

“...almost one in every ten workers in the mining sector is in a compliance role – and that the share of compliance workers within overall mining sector employment is growing faster than in any other industry.”⁵²

Fundamental to this review will be an understanding that:

“Well-designed regulation can serve to improve productivity and competitiveness within the economy, while also meeting broader social objectives. It is the role of government to ensure that these benefits are not outweighed by the costs.”⁵³

⁴⁹ Deloitte, (2016) “Get out of your own way: Unleashing Productivity”

⁵¹ DIIS (July 2015) “Developing the Regulations Reform Agendas – Guide for Growth Centres”

⁵³ *ibid*

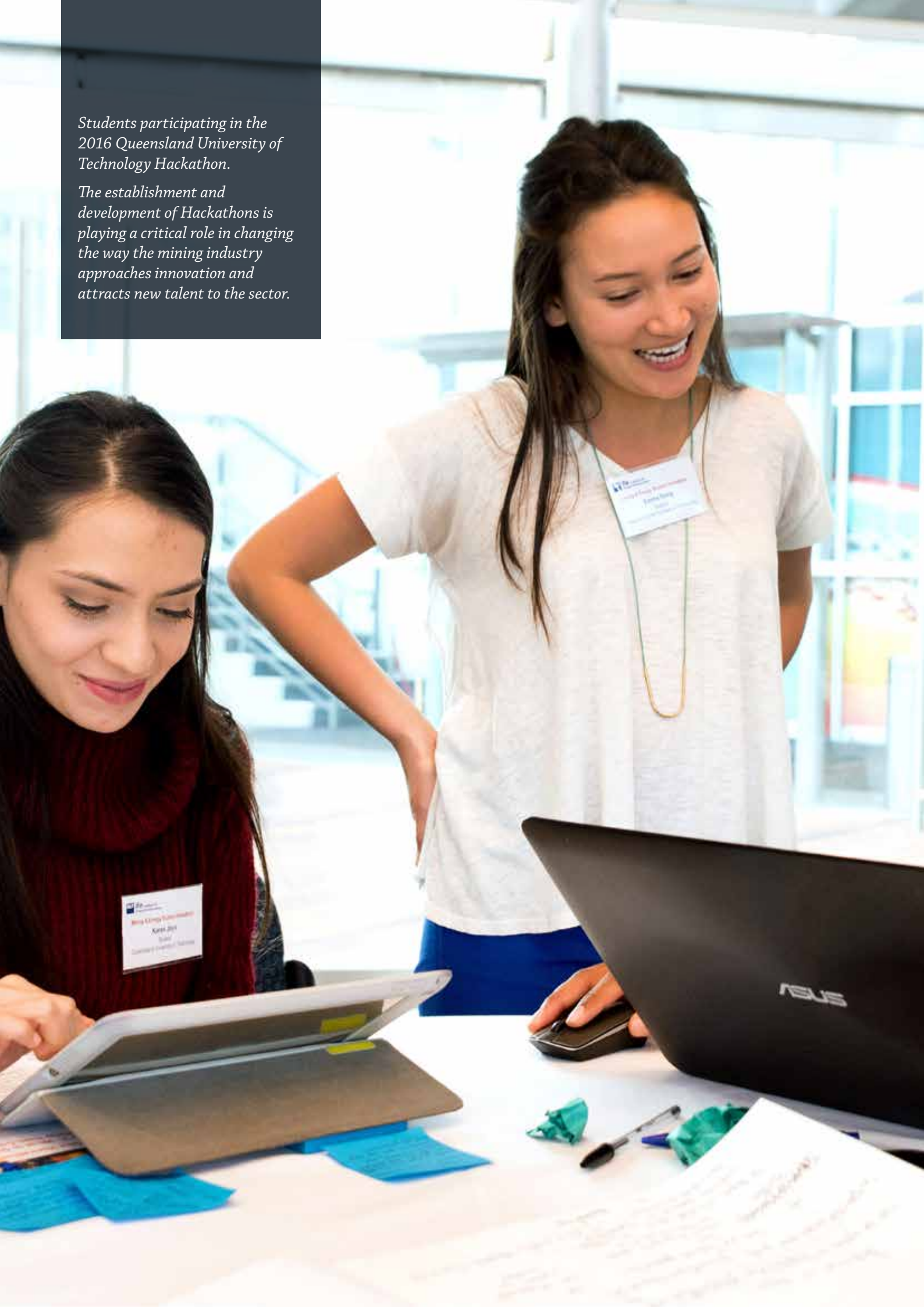
⁵⁰ Minerals Council of Australia (September 2013) “Policy Brief for the Forty-Fourth Commonwealth Parliament”

⁵² Deloitte, (2016) “Get out of your own way: Unleashing Productivity”



Students participating in the 2016 Queensland University of Technology Hackathon.

The establishment and development of Hackathons is playing a critical role in changing the way the mining industry approaches innovation and attracts new talent to the sector.





9

Industry Knowledge Priorities

Industry Knowledge Priorities

The Industry Knowledge Priorities (IKPs) highlight what the METS sector requires now and into the future from Australian research providers and innovators.

The METS Ignited Board, working together with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Austmine has defined IKPs for the METS sector in the following way:

“Industry Knowledge Priorities are those outcome-focused bodies of information or skills that need to be developed to create sustainable global competitive advantage for the Australian METS sector.”

In identifying the IKPs for the sector, the outcomes being targeted include:

- the identification and development of opportunities for significant/step-change improvements in the economic, social and environmental benefits from mining
- increased commercial development opportunities to address domestic and global mining challenges
- increased input from a diverse range of stakeholders, including those from outside the mining sector
- the creation of critical mass through identifying and developing clusters formed around either specific expertise/knowledge areas or around natural geographic groupings of complementary skills/knowledge areas.

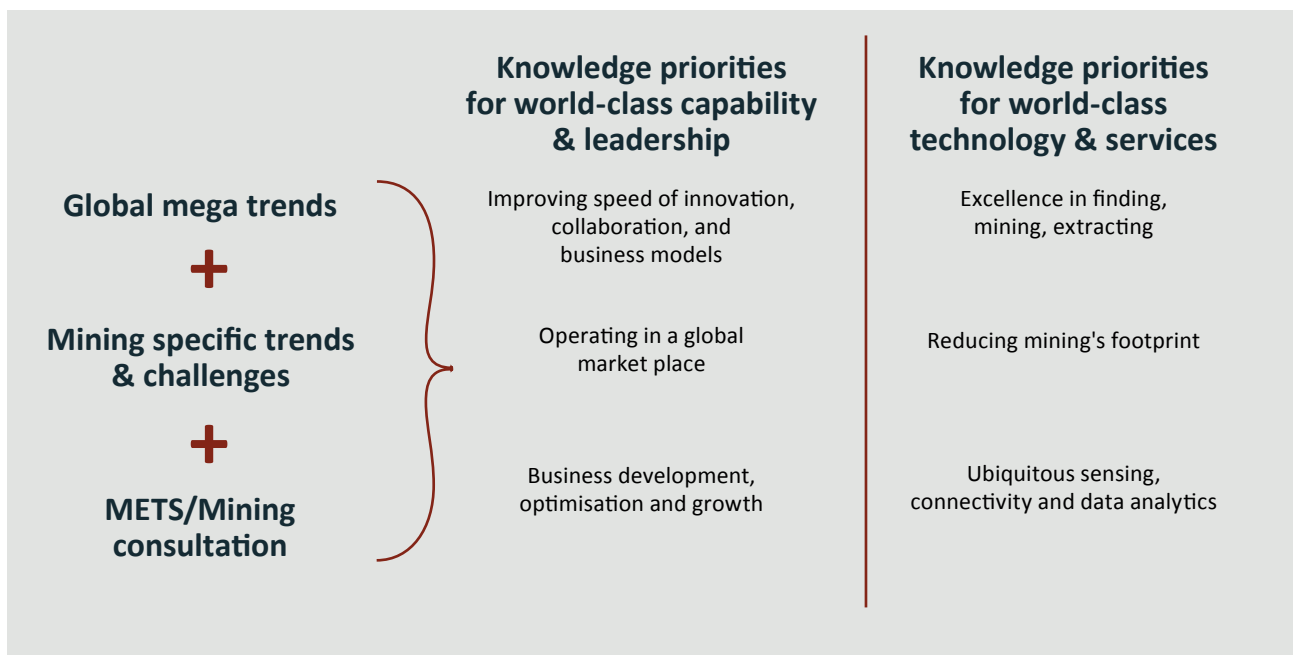
The IKPs fall into two broad categories:

- the management skills and capabilities needed to make the sector more competitive
- the research and development required to ensure that the sector remains relevant.





The IKPs have been assembled through consultation with the METS and mining industries, as well as through input from CSIRO, Austmine, and a VCI report on the sector commissioned by METS Ignited. Further, the IKPs have been shaped by global megatrends⁵⁴ as well as current and emerging challenges and technology trends.



⁵⁴ CSIRO's Our Future World: global megatrends report

Knowledge priorities for world-class capability and leadership

IKP1:

Improving speed of innovation, collaboration and business models

Australians have a strong reputation for their ability to innovate and for the quality of their innovation. However, we have a mixed record for commercialising our innovations. Growing the sector requires reducing innovation cycles and barriers, collaborating for mutual benefit, and the adaption and development of new business models. Two-way education between METS and capital markets will provide the fuel for growth.

Priorities for improving the speed of innovation, collaboration and business models include:

1. Determining the factors limiting speed and implementation of innovation in the Australian METS/mining/research system.
2. Enhancing methods for METS cluster development, both regional and niche-driven, including soft infrastructure and industry development programs to drive business growth.
3. Advancing knowledge and understanding of models and behaviours of successful systemic innovation and collaboration, and new business models in an Australian METS/mining context, including understanding of design-led innovation and frameworks to foster these processes.
4. Advancing knowledge and understanding between the METS sector and capital markets.

IKP2:

Operating in a global market place

Global competitiveness is a function of a broad range of complex factors and generally takes considerable time. Growth in the sector will require Australian METS to have a clear understanding of key markets, competitors, and how to engage globally. Priorities for developing the body of knowledge on operating in a global market place include:

1. Developing knowledge and tools for determining trends/growth in key markets for Australian METS.
2. Understanding Australia's global position (incl. brand) and competition.
3. Developing knowledge and tools for profiling key customers/markets and the impact of new mining and METS entrants (e.g. from emerging markets).
4. Advancing knowledge and understanding of global supply chains and how they are best accessed.

IKP3:

Business development, optimisation and growth

Mining is a cyclical industry. Growing strong mining and METS businesses requires advancing the body of knowledge around value and supply chain theory and application, and managing the significant cultural changes which may be required to foster innovation for driving business value. Further, skills attraction and the need for skills to evolve with new technologies is a body of work which needs careful consideration, with particular reference to robustness to changing markets and conditions. Priorities for improving knowledge and capability in business development, optimisation and growth include:

1. Advancing knowledge and understanding of business optimisation methods (e.g. lean manufacturing, theory of constraints, systems theory) in METS and mining.
2. Advancing knowledge for managing businesses in cyclical markets.
3. Change management, leadership capabilities and transformative business models to deliver and capture value from new technology.
4. Advancing knowledge and understanding of skills attraction and retention in changing markets, as well as how skills requirements will evolve with emerging technologies.

IKP4:

Excellence in finding, mining and extracting

Ore bodies are becoming scarcer, deeper, lower grade, and more complex. Further, there is an increasing need to improve return on capital invested for new and installed assets. For Australia to become more globally competitive and take new ideas to the world, we need to leverage strengths in developing, and exploiting, excellence in the METS sector. Priorities for excellence in finding, mining and extracting include:

1. Advancing exploration knowledge, tools and technologies, including for deep and unconventional resources.
2. Advancing mine autonomy, equipment/process mechanisation and automation, including operator-assist systems, and maintenance.
3. Advancing mining and beneficiation technologies (e.g. selective mining, comminution, classification, reducing tailings/reject streams, in-situ recovery, small scale robotics for continuous mining, bio-leaching and nano-technology).
4. Advancing knowledge and understanding of modular solutions, standardisation and interchangeability (e.g. for provision of mobile or incremental processing and materials handling capacity, plug and play capability, etc.).

IKP5:

Reducing mining's footprint

In an increasingly connected world, social licence is more important than ever. Just as importantly, despite continued focus and effort, keeping our people, and the environment safe, remains a continuing challenge. As a further motivating factor in addressing the environment, increasing energy costs will drive reductions in energy usage. Finally, and linking back to the social licence issue, excellence in remediation and mine closure will be an increasing requirement. Priorities for advancing the body of knowledge around reducing mining's footprint include:

1. Energy efficiency including closed energy loops, application of renewables, hybrids, and the "electric mine".
2. Improving remediation and rehabilitation techniques and take-up for old, ongoing and future workings.
3. Adaption and application of leading practices in social licence and sustainability.
4. Fast tracking adoption of, and advancing, leading practice in all aspects of health, safety and the environment.

IKP6:

Ubiquitous sensing, digitisation and data analytics

Data analytics and connectivity is yet to truly take hold within mining. A key to this is interconnectivity and interoperability of data, information and systems. Another enabler may be establishing a "mining ontology" for natural language processing. Expertise in data science needs to be complemented with mining domain expertise, and ensuring the systems are useable. Technical elements are necessary but not sufficient – cultural, organisational and change management capabilities are critical for success. Priorities for progressing ubiquitous sensing, digitisation and data analytics include:

1. Advancing sensors and connectedness, e.g. for improving asset health, productivity, environmental and safety performance.
2. Advancing data/information/systems interoperability.
3. Advances in data analytics applied within and across the mining value chain (e.g. predictive/prescriptive asset health monitoring, numerical optimisation, etc.) towards truly integrated operations including addressing cultural, organisational and educational challenges.
4. Developing more effective human/machine interfaces and systems for providing remote presence, augmented reality, and situational awareness.





Bibliography

Bibliography

1. Menalda, Tristan. (June 2016) "Economic Trends for Mining and METS." Australian Mines and Metals Association
2. CSIRO Futures. (May 2016) "Australia 2030 – Navigating Our Uncertain Future."
3. *ibid*
4. Parker, R. Cox, S and Senyard, J. (June 2015) "Options for Developing a Sustainable METS Sector Part 2: Business Models."
5. ANZ Insight. (August 2011) "Earth, Fire, Wind and Water: Economic Opportunities and the Australian Commodities Cycle."
6. ANU Edge. (2011) "On Track to 2040: Preparing the Australian Rail Supply Industry for Challenges and Growth." Department of Industry, Innovation and Science.
7. Austmine. (June 2013) "METS Industry Innovation Precinct - Submission to Department of Industry, Innovation, Climate Change, Research and Tertiary Education."
8. Austmine. (July 2013) "Australia's New Driver for Growth, Mining Equipment, Technology and Services."
9. Austmine. (November 2013) "METS Action Agenda - Submission to the Department of Industry."
10. Austmine. (October 2014) "Australian METS Global Leadership Opportunity."
11. Austmine. (2014) "Mining Equipment, Technology and Services Sector Victoria." State Government of Victoria.
12. Austmine. (June 2015) "New Realities, Bigger Horizons. Australian Mining, Equipment, Technology and Services (METS) National Survey."
13. Austrade. "Mining Equipment, Technology and Services." <https://www.austrade.gov.au/.../Mining-Equipment-Technology-and-Services-ICR.pdf>.
14. Australian Department of Industry. (January 2014) "Building Procurement Capability to Deliver Innovation in Australia - Final Report."
15. Australian Department of Industry, Innovation and Science (July 2015) "Developing the Regulations Reform Agendas – Guide for Growth Centres"
16. Australian Department of Industry, Innovation Science, Research and Tertiary Education. (October 2012) "Best Practice and Innovation by SMEs Supplying the Resources Sector."
17. Australian Department of Industry, Science and Resources. (May 2001) "Backing global competitiveness: government response to the Heavy Engineering and Infrastructure Action Agenda."
18. Australian Department of Industry, Tourism and Resources. (2003) "Mining Technology Services: Australia leading the world." Mining Technology Services Action Agenda, Strategic Leaders Group Report to Government.
19. Australian Mines and Metals Association. (August 2014) "Establishment of the Industry Skills Fund – Discussion Paper." Australian Government Department of Industry. AMMA Resources Industry Market Outlook. Autumn
20. Australian Technology Network of Universities. "Five Universities, one approach to IP." <https://www.atn.edu.au/siteassets/publications/ippublication.pdf>
21. Birrell, Bob (September 2015) "Too few or perhaps too many STEM graduates" The Australian Population Research Institute
22. BIS Schrapnel (2014) "The New Mining Boom in Australia"
23. Bladier, Robert (March 2016) "Innovation and Technology Policy - Implications and Positioning for the Resources Sector." Queensland Resources Council
24. Bremer and Co. (2014) "METS Export Skills Gap Analysis."
25. Bughin, J. Lund, S and Manyika, J. (2016) "Five Priorities for Competing in an era of Digital Globalisation." McKinsey Quarterly, May
26. Committee for Economic Development of Australia. (June 2016) "Australia's Economic Future: an agenda for growth."
27. CSIRO. (January 2016) "Tomorrow's Digitally Enabled Workforce: Megatrends and scenarios for jobs and employment in Australia over the coming twenty years."
28. CSIRO Futures. (May 2016) "Australia 2030 – Navigating Our Uncertain Future."
29. Deloitte (2015) "Innovation State of Play - Mining Edition." Canada
30. Deloitte. (2016) "Innovation in Mining." Africa
31. Deloitte, (2016) "Get out of your own way: Unleashing Productivity"
32. Dobbs, R. Oppenheim, J. Kendall, A. Thompson, F. Bratt, M and van der Marel, F. (2013) "Reverse the Curse: Maximising the Potential of Resource-Driven Economies." McKinsey Global Institute, December.

-
33. Erzurumlu, S and Erzurumlu, Y. (2014) "Sustainable mining development with Community Using Design Thinking and Multi Criteria Decision Analysis." Elsevier Ltd.
 34. Forsknings, Gruv. (April 2016) "Strategic research and Innovation Agenda for the Swedish Mining and Metal Producing Industry (STRIM)." Vinova
 35. IBIS World. (February 2016) "Mining Support Services in Australia."
 36. IBIS World. (May 2016) "Mining in Australia."
 37. Joint Select Committee on Trade and Investment Growth, (May 2016) "Inquiry into Australia's Future in Research and Innovation" Commonwealth of Australia
 38. KPMG. (12 March 2015) "Workplace Relations and the Competitiveness of the Australian Resources Sector." Australian Mines and Metals Association
 39. Littleboy, A. Arico, S. Bowtell, D, King, P. Law, J. Moffat, K and Wing, N. (August 2012) "Resourceful Supply: The role of innovation in winning work within the supply chain for the extractive sector." CSIRO Mineral Futures.
 40. Menalda, Tristan. (June 2016) "Economic Trends for Mining and METS." Australian Mines and Metals Association
 41. METS Ignited (2015) www.metsignited.org.au
 42. Minerals Council of Australia (September 2013) "Policy Brief for the Forty-Fourth Commonwealth Parliament"
 43. Mining Education Australia (2014) Annual Report
 44. NESTA. (November 2009) "The Wider Conditions for Innovations in the UK."
 45. Nurmi, P. (2013) "Finland's Mineral Strategy." Geological Survey of Finland
 46. Office of the Chief Economist. (2015) "Australian Industry Report." Department of Industry, Innovation and Science. Australia
 47. Parker, R. Cox, S and Senyard, J. (April 2015) "Options for Developing a Sustainable METS Sector Part 1: Procurement Models and Value Chain Relationships."
 48. Parker, R. Cox, S and Senyard, J. (June 2015) "Options for Developing a Sustainable METS Sector Part 2: Business Models."
 49. Parker, R. Cox, S and Senyard, J. (August 2015) "Options for Developing a Sustainable METS sector Part 3: Intermediary Organisations: Possibilities for coordinating engagement in the METS research and innovation ecosystem."
 50. Plastics and Chemicals Industries Association. (July 2014) "Adding Value: A Strategic Roadmap for the Chemicals and Plastics Industry." Version 2
 51. Port Jackson Partners (August 2011) "Earth, Wind and Fire: Economic Opportunities and the Australian Commodities Cycle." ANZ Insight
 52. Porter, Michael E. (1990) *The Competitive Advantage of Nations*. Macmillan Press, UK
 53. Read, Brenda (September 2015) "Australian Regional Industry Associations in the METS sector. Final Report". Advanced Manufacturing Policy Branch of the Department of Industry and Science
 54. Scott-Kemis, Don, (March 2013) "How about those METS? Leveraging Australia's Mining Equipment, Technology and Services Sector". Minerals Council of Australia.
 55. Smith, Kevin. (2007) "Innovation and growth in resource-based economies". CEDA Project Paper 3, Competing from Australia
 56. Stanway, Graeme (March 2016) "METS Strategy Development." Discussion document prepared for METS Ignited
 57. Stanway, Graeme. (May 2016) "METS and Mining: A 20 Year Horizon". VCI
 58. Stanway, G. Mahoney, P. Griebel, C. Stickell, M and Lilly, P. (2016) "Innovation State of Play – CEO Insights, Mining." VCI, EMI and UWA.
 59. Startup WA (December 2015) "Startup Ecosystem Preliminary Report"
 60. Universities Australia (February 2016) "Submission to the Review of the R&D Tax Incentive"
 61. University of Melbourne and Centre for Workplace Leadership. (2016) "Leadership at Work: Do Australian Leaders have what it takes? Study of Australian Leadership."
 62. World Economic Forum. (2015) "Industrial Internet of Things: Unleashing the Potential of Connected Products and Services." www3.weforum.org/docs/WEFUSA_IndustrialInternet_Report2015.pdf
 63. Wright, G and Czelusta, J. (July 2002) "Exorcising the resource curse: Minerals as a knowledge industry, past and present." Stanford University.
-

SN TU 18 74 45 7

S X U 6 1 9 5

W C I U 8 _ 0 1 2 4 6

T P
4 1 5 0 2 0



Appendix

Appendix One:

CSIRO (Megatrends, mining trends and technology trends)

A megatrend is defined as a substantial shift in social, economic, environmental, technological or geopolitical conditions that may reshape the way an industry operates in the long-run. Megatrends occur at the intersection of many trends; they are not mutually exclusive and the trends that make up one megatrend can influence or contribute to another.

CSIRO has identified six megatrends evident in global mining that will have significant impact on the METS sector over the next 20 years. These were developed by applying CSIRO Global Megatrends (below)⁵⁵ to the mining industry. The Global Mining Megatrends are under development and will be released next year within the CSIRO METS Industry Roadmap.

⁵⁵ CSIRO Futures (2016). Australia 2030: Navigating our uncertain future.

CSIRO Global Megatrends



Megatrend analysis CSIRO Global Megatrends

1 MORE FROM LESS

Innovation in meeting human needs by more efficient use of mineral, water, energy and food resources in light of escalating demand and constrained supply

2 PLANETARY PUSHBACK

Changes in earth systems from the global to microbial are creating challenges for humanity including climate change and antibiotic resistance.

3 THE SILK HIGHWAY

Rapid growth of emerging economies and the transition from industrialisation into technologically advanced service sectors.

4 FOREVER YOUNG

The rise on the ageing population, retirement savings gap, lifespans, healthcare expenditure, diet & lifestyle related illness and mental health awareness.

7 GREAT EXPECTATIONS

The rise of the all important experience factor as society and consumers have rising expectation for personalised and positive experiences involving social interaction, morals & ethics and the physical world.

6 POROUS BOUNDARIES

Changes in organisational models, governance systems and employer-employee relations in a more agile, networked and flexible economy which breaks through traditional boundaries.

5 DIGITAL IMMERSION

The exponential growth in computing power, device connectivity, data volumes, internet users, artificial intelligence and technological capabilities.



CSIRO Global Mining Megatrends



Megatrend analysis Global Mining Megatrends

1. The Innovation Imperative

Falling commodity prices, declining ore grades, decreasing productivity and rising costs are compelling the mining industry to focus on innovation. Companies require new solutions and technologies to become more productive, less water and energy intensive, more sustainable and ultimately more profitable.

2. Plugged In and Switched On

Digital technologies, data analytics and automation along with greater mobility and increasing connectivity is creating exciting opportunities for the mining industry. These connected technologies are accelerating safety and productivity and driving disruptions across the mining value chain and life cycle.

3. The Era of Accountability

Mining companies are expected to be good corporate citizens, meeting public expectations regarding accountability and environmental and sustainability considerations. Earning and maintaining community support for mining projects will be imperative for risk management over the next twenty years.

6. Rethinking our Reserves

Rates of discovery for high-quality and accessible ores are declining and not keeping up with depletion leading to the need for continued exploration and solutions that extend the life of a mine through more effective processing of low grade ore bodies. At the same time, greater social expectations are leading to a rise in recycling and discussions of our urban (or above ground) mining reserves.

5. The Knowledge Economy

Developing countries are emerging as key suppliers of mined resources globally. However, many lack the trained staff required for efficient and sustainable exploitation of mineral reserves. This presents a new market opportunity for developed countries to export their advanced knowledge, skills, expertise and technology.

4. New Supply, New Demand

Increasing urbanisation and rapid development of emerging economies will continue to raise demand for mineral resources – demand which will be met by supply from developing nations. Rapid adoption of new technologies are forcing nations to consider future strategic needs, particularly looking at high-value, low



CSIRO Technology Trends

There are a number of global technology trends that are likely to shape the future of the mining industry, providing technical and commercial opportunities for the Australian METS sector. While not exhaustive, the following provides an overview of some of the major technology areas that are driving change and are likely to underpin future increases in value generation, safety and environmental outcomes for mining.

As with other industries, technology trends in the mining industry are heavily dominated by digital platform technologies and the increasing application of automation (“data automation” and “equipment/process automation”). Developments in these areas have been supported by significant cost reductions and improvements in computing power, communications and storage. In particular, digital platforms are driving a new paradigm of data-driven research, allowing organisations to manage complexity, and to optimise within and across the mining value-chain.

Sensing, monitoring and mapping technologies: Advances in sensors and monitoring devices as well as mapping, imaging and surveying technologies will allow collection of more diverse information across the mining value chain. Examples include sophisticated above and in-ground sensing, acting to increase our understanding of ore-bodies and how best to extract them; the use of distributed sensor networks to provide smarter noise, dust and emissions monitoring to meet increasingly stringent social licence to operate needs; and the application of drones and satellites allowing more efficient collection of spatial data, including in unsafe or hard to reach areas. Together these technologies will help to improve operational context today and supporting remotely managed operations in the future.

Data analytics, machine-learning and visualisation: Existing mining operations already generate huge volumes of data from numerous sources, much of which is not acted upon effectively. Advances in sensing, monitoring and mapping technologies will only add to this “data deluge”. Value is expected to be unlocked through platforms and standards better enabling treatment of information from differing data sources, in combination with technologies such as analytics, machine-learning and visualisation. Together these advances will create new opportunities for real-time, tactical and strategic decision making across the value chain.

Examples include predictive asset health algorithms acting in concert with maintenance scheduling systems; new tools for assessing ore grade during processing, maximising value recovery; and the application of optimisation to address system bottlenecks for value generation, working the right assets hard and not pursuing productivity for the sake of productivity.

Intelligent robotics and automation: Robotics and autonomous systems have rapidly developed allowing improvements in productivity, performance and safety by reducing human error, increasing repeatability, reducing operating costs and removing the need for humans to be in dangerous environments. Mining has already seen the introduction of technologies such as automated drilling and haulage, and the trend is expanding to other equipment, both surface and under-ground. Further, equipment automation may not suit all operations and it is expected that partial automation in the form of operator assists will find increasing application. In the longer term, advances in robotics and automation, along with energy delivery systems such as better batteries, will allow the redefinition of extraction and processing methodologies.

Advanced and intelligent materials: Advances in materials and nano-coatings combined with new manufacturing techniques, such as additive manufacturing (3D printing) will enable a new generation of parts and equipment with novel properties, including increased strength, low weight and responsiveness to external environments. Technology advances are enabling sensors to be embedded within materials, rendering them intelligent; capable of detecting indicators such as stress, temperature, pressure, air and water quality. In addition to reducing maintenance requirements and increasing the useful life of mining assets, these materials open the door to new functional properties for buildings, equipment and tools that are able to self-clean, self-repair, harvest-energy, and reduce corrosion.



Appendix Two: VCI - METS and Mining in 2036

*A thought piece from Graeme Stanway -
VCI Consulting*

Fundamental advances in computing power, artificial intelligence, automation, robotics and biotechnology are creating new opportunities across the resources industry, for which the METS sector is the engine of creative change. In parallel, strong economic growth and demographic change in developing countries is introducing billions to the global middle class. The companies who successfully meet this challenge will be agile, innovative and connected with the world outside Australia.

In this emerging future, Australian METS companies can be optimistic given their considerable natural advantages. They operate within one of the largest and most advanced mining sectors in the world, they are close to Asia - which is retaking its place at the centre of global economics - and have access to

a highly educated, diverse and innovative workforce. Other countries recognise the Australian brand as one of high standards that is clean, safe and well supported by regulation and policy frameworks which are stable and advanced. The biggest risk for Australian METS is complacency.

This introduction is designed to create a snapshot of what the mining industry could look like in 20 years. It is based on a series of plausible futures that have been imagined based on projections of technology and business model drivers in key areas of the industry.



The World In Which Miners Operate

The world is continuing its virtuous cycle of trade, specialisation, competition and innovation that has lifted real global living standards [10 times] over the last 200 years. This journey is, if anything, likely to accelerate as we enter into a period of revolutionary advances in technology. It is forcing closer global integration, increasing urbanisation, and driving huge changes in how we live through energy, transport and communications. Communities have ever higher expectations of governments and companies through the impact of information and transparency, and increasing wealth. Here is just a glimpse at how these forces may change the industry.

Global Economic Development

The world will look very different in 2036. We will likely be talking about the peak of the India boom and the slowing of twenty years of consistent minerals demand growth - continuing a 60-year boom bust pattern (Japan peaked in 1987, China in 2011). China and the developed world - the large, but diminishing, traditional minerals demand growth centres - will remain. The next boom will be in its infancy driven by the remaining three billion people whose resource demand is miniscule. Once again we will be envious of the winners who pre-empted the boom, and diagnosing the failures of those that made value destructive, pro-cyclical investments.

The METS industry will be dramatically altered from today, servicing a global resources industry with higher aggregate demand, but with far fewer high quality, near surface resources. Therein lies a prize for Australian METS companies.

Technologists will be tasked with finding new ore bodies underground and underwater and developing economic extraction methods for these resources. Therein lies a prize for Australian METS companies.

With a combined GDP greater than the US, China and India will dominate advanced manufacturing and services. Sixty percent of the global middle class will reside in Asia, driving demand for quality products. Global economic activity will be dominated by groups of mega cities whose density and scale drives higher innovation than elsewhere. Australian METS companies will see partnerships with their Asian peers as a core part of their business, developing integrated intellectual property and sourcing world class services in these growth centres.

Social Expectations

The increasing march of social expectations will drive huge change in the METS industry by 2036. Data sensing and information transparency will have progressed to the extent that they know no practical limits. This transparency will catalyse a new level of scrutiny and activism, forcing policymakers to implement environmental impact and rehabilitation regulation that will lead to the mining industry being recognised as a globally advanced, technologically progressive industry driven by highly specialised METS companies. Miners will have no choice.

In 2036, mines will be designed on the basis of their systemic impact on the environment and local economy, beginning with minimising the need for end of mine life rehabilitation. Designs will have evolved so that rehabilitation is integrated with ongoing operations; and laws will have changed to ensure that liabilities cannot be sold on unless fully funded. Legal action against the largest companies mean businesses are held accountable for the social performance of their entire supply chain. Closed loop management for zero net impact will be both technically feasible and mandatory by law in the developed world.

Mining operations will be monitored continuously via drones, satellites and sensors whose data is made freely available online. The future health impacts of mines and specific minerals will be able to be predicted and mitigated accurately through advances in proteomics and genetics.

Ultimately, even the most progressive communities will seek to have high tech mines located nearby due to the opportunities provided by proximity to an industry that is as advanced as any in the world.

Evolution of Minerals Demand

The minerals that comprise demand in 2036 are distinctly different to those in 2016 due to the impacts of technology change on the end use of raw materials.

Advances in technologies such as computing, robotics, energy, construction and engines among others – reinforced by steady global economic growth – will place previously uncommon, specialty industrial minerals and rare earths under severe supply side constraints.

A world will have emerged in which certain rare earths are at the centre of simmering global tensions due to the need to secure supplies that are vital to industrial performance. The first real warning of such being the US reaction to a sudden lack of import availability of the aircraft raw material, rhenium, 20 years earlier.

The biggest changes will have been driven by energy. Global power generation will be revolutionised by the impact of a combination of solar energy, battery storage and smart distribution grids – which by 2036, will have been cheaper than coal in India for 15 years. This will result in effectively replacing traditional fossil fuels as the preferred baseload energy source for new capacity. Demand growth for industrial materials used in these technologies will have grown massively, while fossil fuels will be in sharp decline. Fortunately, by 2036, Australian METS companies will have been able to diversify from their concentration on coal two decades earlier.

Mineral Supply Provinces

The mining industry of 2036 is even more global and integrated than in 2016. Advances in exploration technology have led to far greater clarity in economic potential of mineral rich basins. Currently underdeveloped regions – such as the Birimian basin in West Africa – have been fully opened up and new ones are emerging. Until the 2020s, most miners had only focused on surface and near surface deposits using conventional extraction techniques. However, by 2036, small scale, fully automated, 'ore-only' extraction technology has rendered a whole new category of underground deposits economically viable and they are coming online.

The developing world will have overcome the risk based reticence of global investors through the adoption of greater transparency and improved governance. This in turn has enabled the emergence of new, highly successful mining companies, based in these previously underdeveloped basins, such as Vale fifty years earlier – including those in Asia, Africa, Russia and South America. New global scale METS companies have also grown to support these businesses with their advanced technology based service needs.

Driven by increased expectations and regulation and with advances in extraction technology, miners in the developed world have shifted markedly to 'low impact' underground operations – and, increasingly, to deep underground. North America and Europe will see a resurgence of mining, as minerals self-sufficiency imperatives drive political will – in much the same way that energy self-sufficiency drove the exploitation of unconventional gas in the US early in the 21st century.

The World of Mining Operations

Exploration

Quality minerals deposits that were only imagined in 2016 will become reality by 2036.

Transformational improvements in exploration technologies enable high geological visibility at depth and largely overcome the previous over reliance on human instinct and intuition. These advances will dramatically change the economics of drilling, increasing its accuracy and effectiveness by an order of magnitude. Consequently, the world of 'minerals on tap' will become closer to reality – supported by new automated extraction technologies – with significant increases in the number of identified economic underground mineral deposits. Investment in this area will result in business models that evolve around a geological technology 'space race' as companies scramble to identify and control new high quality resources underground to an extent not seen since the 1960s and early 1970s.

As value increasingly accrues to those controlling the advanced exploration and extraction technologies (many of which will originate from outside the industry), the old economic order of mining company assets will be severely tested. METS companies will assume a much higher level of influence in the global mining industry, as they develop and deploy the technology that enables this step change.

Extraction methods

Broader advances in the fields of low cost sensing, computational power, analytics, robotics, automation and biotechnology will usher in an era of unprecedented innovation in how minerals are extracted from the earth by the 2030s. The historical preference by major miners for the relatively simple open pit mining method will erode as unmanned underground technology becomes safer, more reliable and more economic at depths up to and beyond 5,000m. Removing most visual impact from mining operations, coupled with full automation, also leads to a huge reversal in how mining is perceived by the increasingly urban population.

Increased precision in mining methods results in the goal of 'only the ore' being extracted as a realistic objective by 2036. As the automation of resource extraction becomes more complete and therefore both safer and more productive, the commentary surrounding the depletion of surface resources that will dominate the later 2020s – or 'peak minerals' – will fade away. Furthermore, it will further shift the value accretion in mining towards the identification of ore bodies in the first place.

Bulk open-pit mining in the 2030s will be characterised by the decreasing scale of unmanned equipment. Continuous mining methods that allow smart tracking and the separation of ore and waste, as these are mined will create huge opportunities for Australian METS companies – such as run-off- mining, selective mining and ore sorting. Modularisation will hold the design key for enabling the rapid upgrading and maintenance of equipment in such highly integrated, continuous systems.

The constraints that stopped the emergence of these new ways of mining began being removed through the 2010s. The METS industry lead the way in applying advanced geo-mechanics and fracturing techniques, small bore tunnelling technology and solvent extraction approaches. This shift will be supported by increased computing power and analytics to unlock huge efficiencies in both bulk and seam only mining, facilitating the move to deeper, wetter, more difficult ore bodies.

Operations

Underpinned by six decades of Moore's law and supported by advances in quantum computing, the mining and METS industries begin to operate in ways once considered the realm of science fiction. Practically everything and everyone is connected to everyone and everything. Mining operations will capture data through physical and visual sensing, which will have become universal, low cost and integrated.

The role of people in mining organisations will change substantially in the next 20 years. Technology will have removed people from physical harm long ago, while computers will take over increasing amounts of 'intuitive' decision making. Computers build the capacity to pattern and make intelligent decisions well beyond that of humans, except where the broadest context is required. People will be valued on their ability to 'collaborate' with machines as well as other people.

Shorter term decisions will be fully automated due to the sheer complexity of optimisation tasks. Longer term decisions will still require human contextual judgement but this will be 'calibrated' to minimise inherent human biases. Extreme transparency of decisions, by today's standards, will characterise management in 2036, and they will be fully supported by simulations of relevant futures and decision pathways.

Operating hierarchies will consequently become very flat and project based, with the common management philosophy championing specialist taskforces increasingly becoming the norm. People's training will be based on purely 'on the job' training as any functional knowledge is either incorporated in the software or with the software developers, emphasising the ability to interpret data and problem solve.

In 2036, all mining equipment will be autonomous and controlled as part of an integrated value chain system which will be optimised using artificial intelligence on a market pull basis, creating highly responsive production systems. Integration with preferred customers and suppliers will become seamless. Maintenance that isn't automated will be undertaken by staff assisted by augmented reality technology.

Robots and drones will be cheap and ubiquitous and will carry out ad hoc physical tasks with zero risk to people. The appearance of self-driving cars on our streets before 2020 was have been just a sign of things to come. The robotic toys that can see, catch, run and learn with children that become popular during the 2020s will be just another example of consumer technology being introduced to the industrial sector.

Conclusion

Business models and value creation

As in most other industries, by the 2030s the mining and METS industry will have been transformed by fundamental global trends driven by technological change and global integration. This will be a radical departure for an industry whose core business models had remained constant for over a century. Increased global competition and technological advances will cause companies to specialise ever further and faster to compete.

The search for value will create sophisticated networks of specialist companies willing to cooperate to capture value through optimisation of the value chain, underlining the relentless push for efficiency that fuels modern economic growth.

By 2036, international competition from emerging mining centres will have created an industry comprised of a limited number of competing value chains, each built around a distinct approach to mineral extraction and end use, with the uncertain path of innovation taking them in different directions. Mining companies themselves will have become primarily custodians of ore bodies, capital and brand, outsourcing the act of mining to a network of these specialists.

Value chain optimisation will be enabled through the seamless integration of specialists on transparent information platforms. Individual companies will compete to provide services within the broader system, measured clearly through data transparency and analytics, based both on their capability and ability to integrate.

The METS ecosystem will increasingly become the operational face of the mining companies, assuming the collective social responsibilities of representing the brand that this entails. The values established by the mining company will shape the expectations of each supplier for social and environmental performance.

Australian METS companies are very well positioned to take advantage of these new business models, effectively using their developmental head start to ride the wave of Asian growth and establish their brand and capability beyond Australia's borders. One thing is certain, 2036 looks nothing like 2016. The companies that don't evolve will become historical footnotes, as is always the case. The opportunity is clear, the challenge is to accept it.

The future for the Australian METS Industry will be:

- more global in mining provinces and customers
 - more focused on industrial minerals and less on fossil fuels
 - more underground and increasingly deeper
 - more focused on data, analytics, automation and remote operations
 - more specialised service companies, agnostic to industry sectors
 - more integrated and competing value chains
 - more open and transparent in all aspects of performance
 - more focused on community social and economic dividend.
-

Appendix Two (Continued)

VCI Future Mining Archetypes

Drivers

Detailed future mine archetype descriptions: Intelligent Resource Factory



Fully autonomous, self optimising, zero entry operation

Advances in robotics, automation and machine learning lead to a zero-entry mine run entirely by autonomous robots and remote control machines in a continuous self optimizing operation

- Autonomous machines used for all repetitive tasks, human remote controlled machines used elsewhere
- Machines make decisions autonomously and communicate to each other
- Network of machines are capable of self optimizing unit operations and across the value chain
- Maintenance is undertaken by other robots resulting in self healing system
- New ore bodies unlocked in areas too risky or expensive to send humans

Underpinning technologies

- Robotics and automation
- Artificial intelligence
- Machine learning
- Ubiquitous sensors
- Advanced optimisation



Appendix 2

Detailed future mine archetype descriptions: Small Footprint Extraction



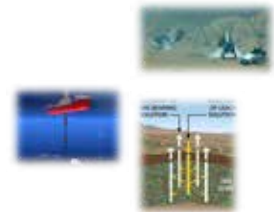
Novel extraction and mining techniques minimises impact

Advancements in low impact extraction and processing technologies drive a productivity step change, minimise inputs required and unlock new tier one ore bodies

- Possible new mining techniques include in-situ extraction and undersea mining
- Step change in small scale continuous mining machines
- New extraction techniques including nanotechnology and bio-leaching
- Non ore carrying material can be left undisturbed reducing costs through lower energy consumption
- Closed loop energy cycles
- Reducing the effort required to produce metals

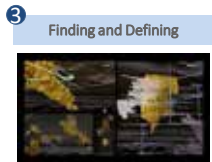
Underpinning technologies

- Rock Fracturing
- Small Scale Robotics
- Nanotechnology
- Bio-leaching
- Ore body understanding



Drivers

Detailed future mine archetype descriptions: Finding and Defining



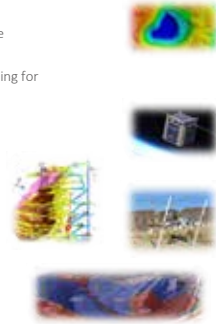
Advanced interpretation of expanded local and global data sets

Step change in ability to find new ore bodies and continually refine their definition through widespread local and global data capture and advanced interpretation

- Continuous capture of data from all parts of the operation continually refines the real time ore body model and mine plan
- Advancements in first principles of rock formation provide more effective interpretation of data and development of new search techniques
- Capturing of all historical global information used to improve the patterning for prediction and interpretation of the ore body
- Computing advancements enable the step change in ability to interpret exponential data growth

Underpinning technologies

- Exploration sensors
- Data capture methods including contextual capture
- Advanced data interpretation
- Data storage and processing
- Ore Body Simulation



Drivers

Detailed future mine archetype descriptions: *Nothing Unknown*



Ubiquitous data, full connectivity and system learning

Ubiquitous sensing across all areas and components of the value chain, fully connected and correlated, with continuous system learning allowing full prediction and optimization of operations

- Sensors on everything from ore body to machine components, to people, to market
- All data regardless of source is connected, correlated and accessible
- Intelligent computing scans real time information providing operational optimization recommendations from market to ore body
- Intelligent computing advises on redesign of processes based on patterning of past, present and predicted future information

Underpinning technologies

- Intelligent, distributed sensors
- Unlimited data storage and processing capacity
- Improved processing technology and algorithms
- Cognitive computing
- Visualisation and machine / human interfaces



Drivers

Detailed future mine archetype descriptions: *Platforms and Modularity*



Plug and Play equipment and modular design drives productivity

Step change in capital and operational productivity and industry innovation due to a focus on modularity and standardization and interchangeability

- Enables innovation through widening the ecosystem of suppliers to innovate
- Removal for proprietary supplier monopolies reduces supplier rent extraction
- “Plug and play” enables continual upgrades in technology without any re-design driving productivity
- Step change reduction in onsite maintenance with consequential infrastructure and people savings
- Shift from bespoke to manufactured modules reduces cost and ramp up times
- Increases certainty in project delivery

Underpinning technologies

- Industry level platform development
- Standardised equipment interfaces
- Open source design



Appendix Three

AMMA Economic Trends

Economic trends for mining and METS

The METS sector and the mining industry are closely entwined, with the state of the mining industry correlated to the trajectory for METS. In recent times, we have seen contraction in mining flow on to challenges for METS operations.

The mining industry is going through near unparalleled downturn, with the index of base metal commodity prices (in AUD) now down 50% its May 2007 peak. As a consequence, mining companies have endeavored to minimise all but essential spend, and the domino-effect of this strategy has impacted METS operations.

Despite such challenges, the Australian METS sector remains globally significant. For context and comparison, the Australian METS sector generates more revenue than the entire Luxembourg economy, and the value of Australian METS exports exceeds the entire GDP of Iceland.

Looking forward the value of Australia's resource exports are expected to rise from A\$105.1bn in 2014-2015 to A\$135.4bn in 2020-21. This forecast rise is attributable to moderate commodity price growth in conjunction with rising volume growth, underpinned by strong demand fundamentals, such as forecast year-on-year economic growth in advanced and emerging economies, as well as projected rises in urbanisation and the global 'middle' class. This projected demand-side growth is a positive sign for the METS sector.

The innovation age brings unprecedented opportunities for Australia's mining industry, and innovation in mining will in substantial part rely on the ideas, energy and drive of the METS sector.

The next wave of mining-related activity will look very different from what we saw in the past, as a function of fundamental structural changes and exceptional trends impacting the mining industry.

This will have significant ramifications for the METS sector:

- The sector is under unprecedented innovative and technological pressure to rethink, reshape and deploy new

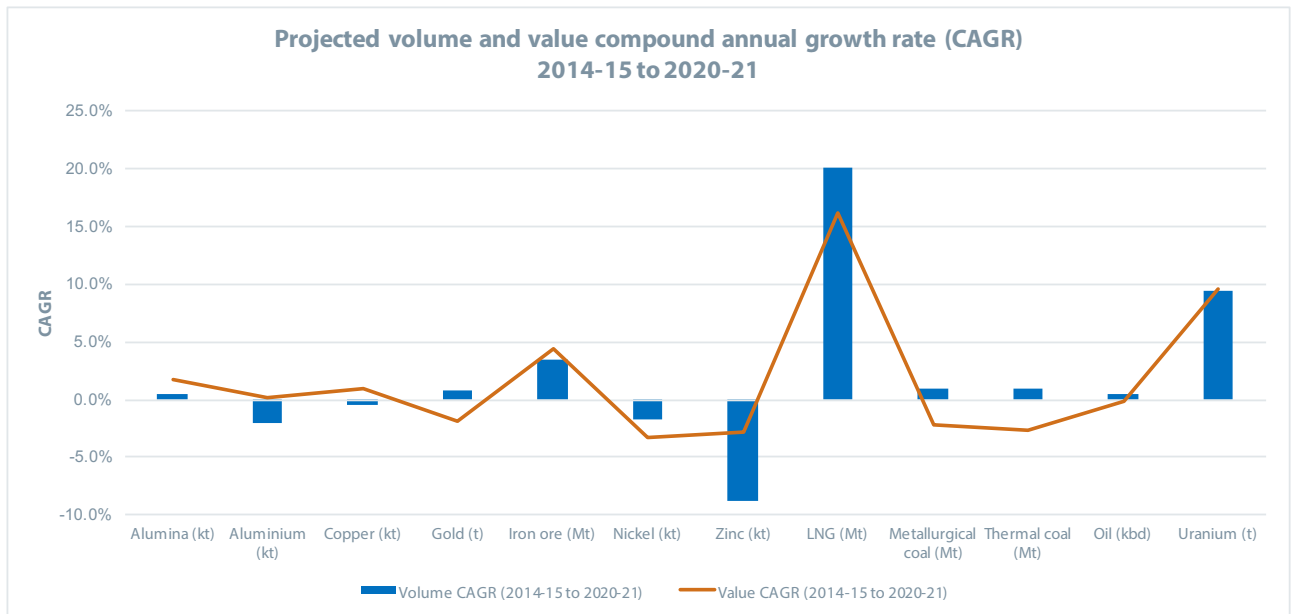
mining techniques and service deliveries. These pressures arise from:

- ↳ prolonged volatility and suppressed commodity prices, increasing scrutiny of cost management and margins.
- ↳ mining multifactor productivity falling 43% from its peak.
- ↳ aging mines, with reserves depleting and falling ore grades.
- ↳ aging equipment.
- ↳ future supply concerns arising from: critically low exploration; declining tier one discoveries; and major projects being scrapped or put on hold.
- ↳ focus to improve mining recovery rates.
- ↳ pressures to increase obligations under the banner of "social licence to operate".
- ↳ Significant landmass left unexplored, underexplored with outdated technologies.

METS companies face demands to deliver implementable solutions that maximise value and profitability, reduce opportunity costs and mitigate against potential adverse scenarios. Not only are project proponents looking to the METS sector for advancements in core mining production, but demand is expanding to allied industries, such as construction, education and training.

In order to deliver new METS solutions, improved collaboration and commercial agreements is required between new and traditional METS sector providers. Consequently, while collaboration delivers solutions, it is also dispersing IP, which is gradually reshaping and disrupting the traditional METS sector (buyer-supplier) environment. As a result, there are exciting opportunities for leading-edge METS sector companies to grow and diversify, particularly over the mid-to-long term.

- The traditional contractual and engagement model between resource companies and METS providers is radically



changing, moving away from an autocratic buyer-supplier relationship towards early collaboration and engagement. Stark spin-offs are starting to be observed, such as resource companies acquiring METS companies’ IP and advancing their own in-house capabilities, research and development technological/innovation centres of excellence. On the flip side, there is also a trend towards METS companies agreeing to larger ‘at risk’ financial incentives for agreed performance, outcome and delivery.

- There is a structural shift in our economy away from non-renewable to renewable energies. Internationally, according to Bloomberg New Energy Finance, over the next 25 years fossil fuel power will attract \$2.1 trillion dollars in investment in coal and gas generation, predominantly in emerging economies. Renewables however are projected to attract \$7.8tr in investments into green power, \$3.1tr into onshore and offshore wind power, \$3.4tr into utility-scale, rooftop and other small-scale solar generation, and \$911bn into hydro-electric generation.

We can expect METS companies to “follow the money” and look at ways to capture new commercial opportunities, for example through the development and deployment of new battery storage, or carbon capture and storage.

- Consumer demand and the intensity of consumer demand for commodities is changing as a result of technological advances, societal changes, the rising global middle class, as well as higher economic growth targets particularly from emerging nations.

In response, we are starting to see an emerging trend towards resource companies looking to diversify and expand their portfolio of assets and prioritise exploration for rare earths and critical metals such as cobalt, nickel, zirconium, tungsten, manganese, titanium, tin, lithium and tantalum. As each commodity has its own growth trajectory and idiosyncratic characteristics, METS sector companies are accordingly starting to weigh up the cost and opportunity of diversifying

into and / or specialising in new critical metals of the future.

- As a consequence of suppressed commodity prices and overall challenging market conditions, evidenced by various projects going into care and maintenance or closure, the demand-supply equilibrium and the carrying value of many mining assets has been negatively revalued. In response, there is an emerging trend towards METS sector companies innovating and developing multi-purpose, cross-industry equipment that, for example, may be used in both mining and agriculture. In future cyclical downturns, having multi-purpose assets will de-risk and safeguard the carrying value of assets from material loss, thereby protecting companies’ financial positions.
- Notwithstanding evolution and diversification in both the mining industry and the METS sector, Australia’s established staple of key export commodities remains significant. It is projected that Australian resource exports such as alumina, gold, iron ore, LNG, metallurgical and thermal coal, oil and uranium will see volume growth until at least 2020-21, and that alumina, aluminium, copper, iron ore, LNG and uranium will see value growth over this same period. With Australia ranked number one in the world for iron ore, uranium, gold, zinc and nickel reserves, second for copper and bauxite reserves, fifth for thermal coal reserves, sixth for shale oil reserves and seventh for shale gas reserves; and with our sun, our wind, our vast landscape, significant opportunities should lie ahead for our the entire resource industry, including the METS sector.

In summary, the future is bright for the METS sector. METS organisations, people, products and solutions are rapidly transforming as the mining industry evolves. In contrast to the past, the METS sector will substantially drive the evolution of the mining industry rather than the other way around, and all must learn to adapt and embrace the changes that lie ahead.

Glossary

| | | | |
|-------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------|
| <i>ACARP</i> | Australian Coal Association Research Program | <i>METS Ignited</i> | The Growth Centre for the METS sector |
| <i>Accelerator</i> | A structured program to help innovative early stage companies swiftly come to market | <i>MRIWA</i> | Minerals Research Institute of Western Australia |
| <i>AMIRA</i> | Australian Mineral Industry Research Association | <i>OECD</i> | Organisation for Economic Cooperation and Development |
| <i>AMMA</i> | Australian Mines and Metals Association | <i>OEMs</i> | Original Equipment Manufacturers |
| <i>Applied research</i> | Research focused on the practical application of theory to business / industry problems | <i>PDAC</i> | Prospectors and Developers Association of Canada |
| <i>ARC</i> | Australian Research Council | <i>PFR0</i> | Publicly Funded Research Organisations |
| <i>AusIMM</i> | Australasian Institute of Mining and Metallurgy | <i>QUT</i> | Queensland University of Technology |
| <i>Austmine</i> | Austmine is the peak industry body in Australia for the mining equipment, technology and services (METS) sector | <i>R&D</i> | Research and Development |
| <i>CRCs</i> | Co-operative research Centres | <i>RMIT</i> | Royal Melbourne Institute of Technology |
| <i>CSIRO</i> | Commonwealth Scientific and Industrial Research Organisation | <i>Roadmap</i> | A plan that matches short-term and long-term goals with specific technology solutions to help meet those goals |
| <i>Data 61</i> | CSIRO's Digital Innovation Arm | <i>RTOs</i> | Registered Training Organisations |
| <i>DIIS</i> | Department of Industry, Innovation and Science | <i>Sector</i> | Refers to the METS sector |
| <i>DFAT</i> | Department of Foreign Affairs and trade | <i>SCP</i> | Sector Competitiveness Plan |
| <i>Ecosystem</i> | The interplay between the METS, mining and research sectors | <i>SMEs</i> | Small to Medium Enterprises |
| <i>IKPs</i> | Industry Knowledge Priorities | <i>T1 miners</i> | Large global mining companies |
| <i>IMARC</i> | International Mining and Resources Conference | <i>T2 miners</i> | Mid-size mining companies |
| <i>Incubator</i> | An unstructured program and environment for developing innovative early stage companies | <i>T3 miners</i> | Small mining companies |
| <i>IP</i> | Intellectual Property | <i>UQ</i> | University of Queensland |
| <i>Living Labs</i> | An all-encompassing term to cover sand pits, test mines, virtual mines, simulations, pilot plants | <i>UTS</i> | University of Technology Sydney |
| <i>MCA</i> | Minerals Council of Australia | <i>UWA</i> | University of Western Australia |
| <i>METS</i> | Mining, Equipment and Technical Services | <i>VCI</i> | A global anagement consulting company focused on the resources industry, based in Perth, Western Australia |

Thank You

The team at METS Ignited would like to thank the following people and industry partners for their assistance and contribution to this plan:

- Department Industry Innovation and Science
- Queensland Department of State Development
- Austmine
- CSIRO
- VCI
- AMMA
- Minerals Council of Australia
- Bendelta
- The BE Counsel

Our heartfelt thanks to everyone who participated and gave their valuable time, insights and passion to the consultation, engagement and socialisation program.



Australian Government
Department of Industry,
Innovation and Science

Industry
Growth
Centres