A review of the minerals industry R&D landscape in Australia

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Introduction

This paper presents an analysis of significant Australian-based R&D programs that are focussed on the minerals industry. The dataset of 65 programs collated by the author early in 2020 provides a valuable representation of the current minerals industry R&D landscape in Australia. The analysis may assist organisations with R&D management including program creation, program/partner selection, portfolio management, and public policy settings.

About CRC ORE
CRC ORE is a Cooperative Research Centre focused on Optimising Resource Extraction. It delivers value to Australia by improving mine productivity, commercial return and environmental outcomes. CRC ORE does this by enabling mining operations to reduce the amount of waste they process and identify increases in overall value. Operators can decrease their use of energy and water. Established in 2010, CRC ORE has made significant progress in rapidly developing and integrating technology from concept to implementation. CRC ORE uses innovative methodologies to develop new technology, or repurpose existing technology, often from outside the mining industry, to significantly reduce the time from prototype to production scale application.
The dataset contains programs being conducted by or with Australian-based ‘Research Service Providers’ (RSPs), most notably Universities and CSIRO. It does not include R&D being conducted in-house by mining and METS companies, or by them with other organisations that are not RSP’s. Despite evidence that expenditure in these categories is larger (ABS, 2019), the dataset was restricted to expenditure involving RSPs for the following reasons:

➜ **R&D undertaken in-house, or with non-RSP partners, is typically focussed on development activities for specific opportunities or assets. As such, the learnings are often of limited value to other organisations.**

➜ **R&D undertaken by or with RSPs typically ranges from basic research to development activities, on less specific medium-long term problems/opportunities, and is more likely to be undertaken collaboratively (including with governments). As such, the learnings are likely to be of more interest and value to a wider group of organisations.**

➜ **Collation of a high-quality dataset from mining and METS companies would be difficult to achieve, due to confidentiality concerns and commercial interests.**

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The following assumptions and limitations are also noted:

➜ **Each line item in the dataset represents a ‘significant’ R&D program (defined as a program with annual funding greater than $0.5m, and/or three or more FTE researchers, forecast for 2020).**

➜ **The ‘minerals industry’ is defined broadly, to cover the full value chain of activities from exploration to the sale of refined mineral and metal products, and associated supporting activities.**

➜ **Some double counting of funding exists, due to a small number of instances where funding flows through two programs.**
Figure 1 gives a summary of the dataset in terms of the annual cash funding (A$) and the number of programs (in brackets), by coarse technical domain and funding source.

<table>
<thead>
<tr>
<th>Source of Funding</th>
<th>Earth Science (Exploration &amp; Orebody Knowledge)</th>
<th>Mining &amp; Mineral Processing</th>
<th>Economic, Social &amp; Environmental</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No/Low government funding</td>
<td>$14m (6)</td>
<td>$57m (19)</td>
<td>$14m (8)</td>
<td>$85m (33)</td>
</tr>
<tr>
<td>CRC program funding</td>
<td>$13m (3)</td>
<td>$36m (13)</td>
<td>$16m (3)</td>
<td>$65m (19)</td>
</tr>
<tr>
<td>ARC program funding</td>
<td>$0m (0)</td>
<td>$13m (4)</td>
<td>$2m (2)</td>
<td>$15m (6)</td>
</tr>
<tr>
<td>Other government funding</td>
<td>$19m (2)</td>
<td>$42m (4)</td>
<td>$3m (1)</td>
<td>$65m (7)</td>
</tr>
<tr>
<td>Total</td>
<td>$46m (11)</td>
<td>$148m (40)</td>
<td>$35m (14)</td>
<td>$229m (65)</td>
</tr>
</tbody>
</table>
The dataset contains 65 R&D programs, with total annual cash funding of $229m. The rough split of funding is 70% from industry and 30% from government. The industry funding is quite well spread across a mix of mining and METS companies. The majority of government funding is via the CRC program and CSIRO. The total funding of $229m per annum might appear to be a large number, but not when compared with the combined R&D expenditure of Australian universities and CSIRO of over $12b (Ferguson, 2019; and CSIRO, 2019), or minerals industry export revenues of over $200b (MCA, 2020). Arguably, for such a large, critical industry, current R&D funding levels are significantly lower than desirable.

The minerals industry has been relatively successful in obtaining government support via the CRC program (currently receiving ~15% of the program budget), but less successful via the ARC program (currently receiving ~ 4% of the ‘Linkage’ program budget). Notably, CRC program funding has recently increased following the creation of CRC TiME (Transformations in Mining Economies) and six CRC Projects (CRC-Ps) focussed on ‘critical minerals’. ARC funding has also recently increased due to the new ‘Centre of Excellence for Eco-efficient Beneficiation of Minerals’, based at the University of Newcastle.

Of the three coarse technical domains, Mining and Mineral Processing is the largest, with over 60% of the programs and annual funding. This is not surprising, as the domain includes most of the core assets and processes which drive the productivity and sustainability of the industry. A more detailed technical domain analysis is provided later in this paper.

Also unsurprisingly, the majority of the R&D programs are based in Western Australia and Queensland. Figure 2 shows a breakdown of R&D funding by State, based on the primary location of each program.

**Figure 2:**
R&D funding split by state

- Western Australia: 37%
- Queensland: 37%
- New South Wales: 10%
- South Australia: 5%
- Tasmania: 3%
Figure 3 provides a ‘bubble chart’ of all 65 R&D programs in the dataset, with the diameter representative of annual cash funding, and the larger programs and organisations highlighted by name. In addition to the programs, the four highlighted organisations below the graph (Amira Global, ACARP, METS Ignited and MRIWA) are involved in funding and brokering R&D. These organisations are not included in the dataset, but are noted as important actors in the minerals industry R&D landscape.
Figure 3 highlights that while the R&D programs vary significantly in size (from $0.5m up to $17m per annum), most are quite small (70% of programs have annual funding of less than $3m). The large number of small programs, the variety of funding sources, the large range of research providers, and the presence of multiple funding/brokering intermediaries, all provide evidence of low levels of industry coordination.

Another concern is the low number of R&D programs and projects focussed on medium to long-term step-change innovations to core industry assets and processes, with the vast majority of actors in the R&D landscape currently focussed on short to medium-term incremental innovation activities.

Two areas of relative strength highlighted by Figure 3, are CSIRO Minerals and the CRC program. The CSIRO has several well-funded programs, and has worked hard in recent times to increase engagement with, and deliver impact for, the minerals industry. As previously noted, the CRC program is well-used by the minerals industry, which currently oversees four CRCs (including recent successful bids: Minex, 2017; Future Battery Industries, 2018; and TiME, 2019) and fifteen CRC-Ps. Despite this, one area of concern is the impending completion of CRC ORE in mid-2021, which will leave a significant void in the R&D landscape. Significantly, this will also be the first time in the 30-year history of the CRC program without a mining and mineral processing focussed CRC.
R&D landscape detail

A detailed view of the R&D landscape, via thirteen value chain elements is shown in Figure 4. The figure shows both the number of programs and their relative sizes (coloured columns and left vertical axis), and also the total annual funding (blue line and right vertical axis). For the purposes of this analysis, program funding was equally apportioned as ‘part programs’ to appropriate elements. Despite this simplification, the analysis is considered to reasonably show the current split of R&D activity across the value chain elements.
‘Minerals processing’ (physical and chemical) stands out as an area of strength, by both program size and funding. The four elements upstream of processing also appear to be relatively well-funded, with the possible exception of ‘mine planning and design’. The ‘mine planning and design’ element contains ten significant programs, but has relatively low total funding of $11m per annum. In addition, approximately half of the funding is focussed on geotechnical engineering or geomechanics; leaving the other half to cover many other important R&D topics (e.g. strategic mine planning, tactical production scheduling, innovative mine designs and mining methods).

‘Asset management (including maintenance)’ R&D has historically been modestly funded. However, this field has seen strong recent growth with the creation of the ‘ARC Training Centre for transforming maintenance through data science’, and growth of the Maintenance Technology Institute at Monash University.

‘Bulk materials handling and logistics’ R&D is weakly funded in Australia. Arguably, the innovation focus in this value chain element is heavily biased to specific applications, with a small amount of R&D focussed on basic and applied research. However, considering the importance of this value chain element, it is likely that many valuable R&D opportunities are currently being overlooked.

Two other elements that appear to be relatively weak from a R&D funding perspective are ‘tailings and waste management’ and ‘social and community’. Although more should be done in these elements, the overall risk position is potentially reduced by noting that ‘health, safety and environment’ is relatively well-funded, and the recent welcome creation of CRC TiME.
Summary

➜ 65 significant R&D programs, with total annual funding of $229m per annum, were identified and used as a basis for analysing the minerals industry R&D landscape in Australia.

➜ Areas of relative strength were noted in ‘mineral processing’, CSIRO Minerals, and the CRC program.

➜ Areas of relative weakness were noted in ‘bulk materials handling and logistics’, ‘tailings and waste management’, and ‘social and community’.

➜ Of most concern, the overall R&D landscape is currently characterised by a majority of small-scale programs, low levels of industry coordination, a low focus on step-change innovation, and total funding lower than should be expected for such a large critical industry.

➜ It is hoped that key stakeholders in the Australian minerals industry, particularly governments, mining and METS companies, reflect on this analysis and act to address these weaknesses.

Acknowledgements and declarations
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The author is a member of the CSIRO Minerals Advisory Council.

The author accepts responsibility for all limitations and potential errors in this work.

References
ABS (Australian Bureau of Statistics), 2019, Research and Experimental Development, Businesses, Australia, 2017-18, catalogue number 8104.0

CSIRO (Commonwealth Scientific and Industrial Research Organisation), 2019, Annual Report 2018/19

Ferguson, H, 2019, University research funding: a quick guide, Parliament of Australia, Research Publications

MCA (Minerals Council of Australia), 2020, Resource exports reach record $290 billion, Media Release on 6th Feb 2020