Where is Australia's Business R&D Investment Scorecard?

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R&D scorecards are vital tools for policymakers. They provide essential data that guide strategic decisions, stimulate investments, and foster an innovation-friendly environment. These tools help ensure that R&D efforts align with broader economic and social goals, ultimately driving sustainable growth and competitiveness.

The Australian Government, through the Industry Research and Development Board, last published the *Business R&D Investment Scorecard* in 1997[1]. This publication provided detailed insights into the research and development investments by the top Australian companies. The OECD published a comprehensive Science, Technology and Innovation Scoreboard, but it doesn't contain company-specific information.

The EU publishes an Industrial R&D Investment Scoreboard that analyses 2,500 companies, but it includes only 10 Australian companies.

Table 1: Extract from the EU an Industrial R&D Investment Scoreboard 2021

World rank	Company	Industry-ICB3 sector name	R&D 2021 (€million)	R&D one-year growth (%)	Net sales (€million)	R&D intensity (%)
194	CSL	Pharmaceuticals & Biotechnology	1,020.8	15.5	9,264.6	11.0
322	TELSTRA	Technology Hardware & Equipment	570.8	-3.6	13,631.1	4.2
375	CBA	Banks	476.0	34.4	15,683.1	3.0
515	ARISTOCRAT	Travel & Leisure	347.9	5.4	3,034.5	11.5
552	NAB	Banks	320.3	-20.5	10,687.3	3.0
1123	COCHLEAR	Health Care Equipment & Services	135.0	8.1	1,051.4	12.8
1556	COMPUTERSHARE	Software & Computer Services	88.9	1.6	2,014.1	4.4
1873	NUFARM	Chemicals	71.9	16.3	2,060.1	3.5
2139	AMP	Life Insurance	59.6	-17.0		
2466	TECHNOLOGY ONE	Software & Computer Services	49.3	13.1	199.4	24.7

Source: EU

PWC once published a list of the world's 1,000 most innovative companies.

Since its discontinuation, information on business R&D investments in Australia has been reported by the Australian Bureau of Statistics (ABS) and the *SRI Budget Tables* published by the Department of Industry. However, these publications do not provide information on R&D investments by individual companies. As a result, we know very little about the companies investing in R&D in Australia.

Towards a business R&D scorecard for Australia

Under Australian and International Accounting Standards, publicly listed companies are required to publicly report R&D in their financial statements. These statements are lodged with the stock exchanges on which they are listed.

An analysis of the 2,200 ASX listed companies undertaken by the Acton Institute for Policy Research and Innovation reveals that only 353 Australian headquartered companies reported expenditures on R&D in 2022-23. A further 54 companies, headquartered overseas and also listed on the ASX, report R&D expenditures. Most of these companies are headquartered in the USA, Israel, Ireland, Singapore and New Zealand.

[1] Australia. Industry Research and Development Board & Coopers & Lybrand Consultants & AusIndustry (1997). *Scoreboard: business expenditure on research and development*. Commonwealth Department of Industry, Science and Technology, Canberra,

The total reported R&D spend through the ASX amounted to $14.7 billion, compared with $20 billion reported by the ABS in the previous year. The ATO and AusIndustry would have data for overseas companies with Australian subsidiaries (with an ABN) who undertake R&D in Australia and are eligible to claim the R&D Tax incentive. But at the moment, that data is confidential.

The purpose here is to report on what the ASX and international stock exchange data tell us.

Australian headquartered research performing companies listed on the ASX

Table 2 lists the 10 Australian corporate R&D investors listed on the ASX who invested more than $100m in R&D in 2022-23. Information for all companies is in Attachment 1. This database constitutes the base information for a scorecard.

Table 2: Australian headquartered ASX listed companies that spend more than $100m on R&D in 2022-23.

Company name	GICs industry group[2]	R&D ($M)	Revenue ($B)	R&D intensity (%)
CSL	Pharmaceuticals, Biotechnology & Life Sciences	1,854.000	19.984	9.3
Aristocrat Leisure	Consumer Services	834.700	6.296	13.3
Fortescue Ltd	Materials	830.300	25.330	3.3
Computershare	Commercial & Professional Services	577.000	4.806	12.0
TPG Telecom	Telecommunication Services	405.000	5.533	7.3
Cochlear	Health Care Equipment & Services	244.900	1.936	12.6
Wisetech Global	Software & Services	185.800	0.816	22.7
Opthea[3]	Pharmaceuticals, Biotechnology & Life Sciences	183.400	0.001	...
Seek	Media & Entertainment	151.700	1.225	12.4
Telix Pharma	Pharmaceuticals, Biotechnology & Life Sciences	128.800	0.502	25.6

It is not known how much of the R&D these companies report takes place in Australia. However, some information can be gleaned from each company's annual report and the explanatory material in its financial statements.

Attachment 1 also informs us that many of Australia's largest companies, including Telstra, Qantas, the four big banks, and the big retailers, do not report any R&D in their financial statements and, consequently, do not provide data to the ASX. There are many possible explanations for this—

- they have shifted their R&D focus to the "D" component, where some innovation-related activities might not qualify for inclusion in the official R&D statistics[4].
- companies may not consider undertaking R&D a core business; although almost all businesses today are technology-intensive, many prefer to acquire software, hardware, and systems from specialised external vendors rather than develop their bespoke solutions.
- companies are not undertaking a large amount of R&D, preferring to invest in other capital expenditure areas.
- the boards of these companies are focused on compliance and shareholder returns rather than engendering an innovation mindset and investment in R&D to support future products and services.

[2] GICS refers to the Global Industry Classification Standard— a method for assigning companies to a specific economic sector and industry group that best defines its business operations. GICS was developed jointly by Morgan Stanley Capital International (MSCI) and Standard & Poor's. This is similar to Industry Classification Benchmark (ICB) developed by Dow Jones and the FTSE.
[3] Opthea Limited, is a clinical stage biopharmaceutical company, that engages in the development and commercialisation of therapies primarily for eye disease in Australia. The company was formerly known as Circadian Technologies.
[4] Under the Australian Accounting Standards, Research is defined as "Original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding", and Development is defined as "The application of research findings or other knowledge to a plan or design for producing new or substantially improved materials, devices, products, processes, systems, or services before they are commercially produced or used". This definition would seem to exclude incremental innovation or continuous improvement. Accounting Standards Board. (2007). *Accounting Standard AASB 138 Intangible Assets*. https://www.aasb.gov.au/admin/file/content105/c9/AASB138_07-04_COMPapr07_07-07.pdf
R&D is the process of obtaining *new knowledge* and using it to improve existing products and introduce new ones.

- companies do not invite nonexecutive directors to join their boards who are committed to the discipline of innovation—contributing to finding new areas of opportunity. NEDS should be able to see innovation opportunities within the company or industry and in the broader social or demographic trends.[5]
- market analysts see R&D as risky and mark down the share price.
- boards prefer to allocate profits to dividends and share buybacks to satisfy institutional investors and keep the share price high.

These hypotheses, if correct, do not auger well for the sustainability and growth of R&D in Australia.

Australian company Atlassian, with headquarters in Australia, is not listed on the ASX, preferring to list on NASDAQ and other overseas exchanges. In 2022-23, the company reported an R&D spend of $2.8 billion (on revenues of $5.307 billion). The company's annual report suggests that a large part of this spending is incurred overseas.

Australian technology companies are drawn to the NASDAQ listing because the exchange offers better access to investors who understand and value technology companies. By focusing solely on the NASDAQ, companies can prioritise investor engagement, particularly those with a strong interest in technology and innovation.

NASDAQ listing offers enhanced liquidity and potentially higher trading volumes. It can also reinforce a company's global profile and positioning as a leading technology company focused on serving a diverse, global customer base. However, the unwillingness of Australian technology companies to list, or stay listed, on the ASX has significant implications for the development and growth of Australian-born technology companies.

On the other hand, CSL Limited, a global biotechnology company headquartered in Australia with substantial operations and listings in the US, retains its ASX listing to reflect its Australian origins and strategic approach to capital markets.

The EU Industrial R&D Investment Scoreboard, reported in Table 1, does include Telstra, CBA, NAB, and AMP among the top 2,500. Inclusion may be on the grounds of a broader definition of R&D than adopted by the International Accounting Standards. There is no record for BHP, but there is for Rio Tinto.

Overseas headquartered R&D performing companies listed on the ASX

Apart from Atlassian, many Australian-born companies that have moved their headquarters overseas or have been taken over by an overseas corporation and are now listed on other stock exchanges (NASDAQ, NYSE, FTSE and European exchanges in particular) remain listed on the ASX.

Table 3 shows the companies in this category that invest more than $100m in R&D, and Attachment 1 provides further details.

Table 3: Overseas headquartered ASX listed companies that spend more than $100m on R&D

Company name	GICS industry group	R&D ($M)	R&D intensity (%)	HQ
Block Inc.	Financial Services	4,099.000	12.7	California
Xero Limited	Software & Services	495.800	37.9	NZ
Resmed Inc.	Health Care Equipment & Services	431.900	6.8	California
Rio Tinto Limited	Materials	359.500	0.5	UK
Light & Wonder Inc.	Consumer Services	334.500	7.9	Nevada
Newmont Corporation	Materials	293.400	1.7	Colorado

[5] Drucker, P.F (2002). The Discipline of Innovation, *Harvard Business Review Magazine*, August 2002,

Company name	GICS industry group	R&D ($M)	R&D intensity (%)	HQ
Fisher & Paykel	Health Care Equipment & Services	163.100	11.0	NZ
Amcor Plc	Materials	151.600	0.7	Switzerland
Life360 Inc.	Software & Services	148.100	33.2	California

The largest reported expenditure, by Block Inc. (formerly known as Square Inc.), is the owner of the Australian company AfterPay, which it purchased in 2021 for $39 billion. This may reflect Australia's strengths in financial services technologies. However, the amount of R&D that these companies undertake in Australia is also not reported.

There are several strategic reasons why overseas headquartered companies retain an ASX listing. Australian investors, including retail investors and superannuation funds, often have mandates or preferences to invest in ASX listed companies. This ensures continuing access to this pool of capital, which can be significant. They may also wish to maintain brand and market presence and relationships with Australian suppliers, customers, and partners.

ASX listing also means continuing to comply with Australian regulatory standards, enhancing a reputation among stakeholders who value rigorous regulatory oversight. It can offer some flexibility in raising capital in both domestic and international markets and potential tax advantages, including access to the R&D tax incentive.

For example, BHP Group, with extensive global operations, has listings on the ASX, the NYSE, and the London Stock Exchange. It maintains its ASX listing to leverage the robust Australian investor base and regulatory environment. But, more significantly, in 2019 BHP stopped reporting R&D expenditures separately in its financial statements.

Apart from BHP, Rio Tinto and Block Inc., global tech companies that buy up Australian start-ups, are not generally listed on the ASX. For example, US conglomerate NetApp Inc., which purchased Instaclustr for $500m in 2022, and has a global R&D spend of $1.6 billion (R&D intensity of 16.4%) is not listed on the ASX; it is not known how much of this R&D occurs in Australia.

Overseas research performing companies that have a marketing, sales, and distribution presence in Australia but are not listed on the ASX

Numerous global research-intensive companies operate in Australia with very substantial R&D investments, but only a small amount of that R&D may occur in Australia, if at all. Some of these companies have Australian subsidiaries with an ABN that would make them eligible to receive the R&D tax incentive—but even so, the aggregate amount is likely to be small compared to their global R&D spend.

So the key question here is how Australia can grab more of this R&D investment?

Below is a sample of overseas companies that spend more than $10 *billion* on R&D and have a marketing, sales, and distribution presence in Australia. Some of these companies do invest in R&D in Australia.

Table 4: Companies that spend more than $10 billion on R&D and have a marketing, sales, and distribution presence in Australia

Company name	R&D ($B)	Revenue ($B)	R&D intensity (%)
Automotive			
General Motors (GM)	14.53	252.10	5.8%
Toyota Motor Corporation	12.18	456.90	2.7%
Ford Motor Company	12.03	258.50	4.7%
Volkswagen Group	25.63	522.00	4.9%
Capital Goods			
Siemens	10.45	127.90	8.2%

Company name	R&D ($B)	Revenue ($B)	R&D intensity (%)
Consumer Services			
Alphabet Inc. (Google)	66.65	451.00	14.8%
Defence			
RTX (Raytheon Technologies Corporation)	10.65	101.10	10.5%
Meta (Facebook), Inc.	56.46	197.90	28.5%
Health Care Equipment & Services			
Johnson & Johnson (J&J)	22.59	124.90	18.1%
Roche Holding AG	24.77	105.40	23.5%
Pharmaceuticals, Biotechnology & Life Sciences			
Merck & Co., Inc.	44.80	88.20	50.8%
Eli Lilly and Company	19.24	50.07	38.4%
Novartis AG	16.68	68.46	24.4%
AstraZeneca Plc	16.16	67.21	24.0%
Pfizer Inc.	15.67	85.83	18.3%
Bristol Myers Squibb Company	14.98	66.03	22.7%
GlaxoSmithKline Plc	11.64	56.73	20.5%
Sanofi SA	10.90	74.56	14.6%
Media & Entertainment			
Amazon.com, Inc.	125.60	843.30	14.9%
Software & Services			
Apple Inc.	46.54	596.20	7.8%
Microsoft Corporation	40.83	318.20	12.8%
Cisco Systems, Inc.	11.35	85.68	13.2%
Semiconductors & Semiconductor Equipment			
Samsung Electronics Co., Ltd	32.19	293.20	11.0%
Intel Corporation	25.36	79.56	31.9%
Oracle Corporation	14.48	76.81	18.8%

A more complete analysis is provided in Attachment 2. Information from the RDTI database, when released later in the year, may shed some light on what and how much these companies invest in R&D in Australia. This could go somewhere towards closing the gap between what companies report in their financial statements and the amount of R&D reported by the ABS and improve our understanding of R&D investment in Australia.

Unlisted private companies

Analysis of the AFR list of the 500 largest private companies does not indicate how many of the 54 manufacturing companies that can be identified undertake R&D. The largest companies in terms of sales are Visy ($7 billion), the Manildra group ($1.6 billion), several meat processing companies, and a handful of specialised food manufacturers.

The gap between ABS and corporate R&D reporting could also be explained by the large number of small privately held companies, including start-ups, claiming the RDTI.

Is R&D changing?

Some industry segments report high R&D intensity, some lower, and some not at all.

The BHP decision not to report was part of a broader move to simplify financial reporting and to integrate R&D costs into general operating expenses rather than itemising them separately.

The change is reflective of a trend among some large corporations to streamline their financial disclosures and focus on core financial metrics that align more directly with shareholder interests and operational performance metrics. However, the decision makes it more challenging for policy analysts, market observers, and other stakeholders to track the company's specific investments in R&D.

Nonetheless, the integration of R&D costs into broader expense categories reflects a strategic shift to embed innovation into its business strategy and operational processes rather than

treating it as a stand-alone activity. These areas relate particularly to automation, sustainable mining practices, and advanced material processing technologies. For example, in its 2022-23 Annual report, BHP informed shareholders that it was "Innovating for the Future"—

> Data and technology, including automation and artificial intelligence, are further unlocking growth opportunities and enhancing our operating performance, enabling us to be safer, more efficient and more sustainable. We're using autonomous trucks at some of our sites across Western Australia and Queensland and extending this to Spence and Escondida. At Jimblebar and Newman, truck automation has resulted in a 90 per cent reduction in heavy vehicle safety risks. *Through BHP Ventures and the Xplor program, we have increased our investment in innovation, building partnerships with companies to help us discover innovative ways to unlock more of the critical minerals needed for the energy transition*.

The company added—

- The advanced use of next generation technologies, such as artificial intelligence, cloud, and data analytics, is enabling quicker and more economic recovery of our existing resources, more safely and sustainably. It is also helping achieve a performance uplift by delivering operational improvements in iron ore, copper, and nickel.
- We expect to be innovative in creating the province and intend to incorporate OZ Minerals' 'Think & Act Differently' approach to innovation. This approach seeks to build capability across the mining value chain to help us better understand future opportunities, find new ways to understand ore bodies, and responsibly extract and process commodities.
- We are using technical innovation, such as new flotation technology, to help lower energy costs and unlock value. We are also looking to secure more copper resources through exploration, acquisition, and early-stage entry.
- Companies within the Group carry out exploration R&D necessary to support their activities.

The report emphasises that its approach to innovation is to create and accelerate *longer-term options* through its venture capital unit and global accelerator programs.

- *BHP Ventures is a* dedicated venture capital unit that "looks for game-changing technologies and emerging companies to help drive ongoing and more sustainable growth within BHP and provide us with a portfolio of new growth options for the decades ahead. "It complements the innovation already under way within BHP by forging new partnerships and creating fresh opportunities to strengthen our portfolio and support the decarbonisation of our operated assets and decarbonisation opportunities in our value chain".
- *BHP Xplor* is a global accelerator program targeting innovative, early-stage mineral exploration companies to find critical resources necessary to drive the energy transition. We are searching globally for the next generation of explorers to unlock copper, nickel and other critical mineral deposits. In January 2023, BHP Xplor announced its first cohort of seven companies, with each received a cash payment of up to US$500,000 and access to a network of internal and external experts to support the development of their opportunity and potential investment options for BHP to accelerate the exploration for minerals needed for the energy transition.

In other words, BHP has shifted its emphasis from the vertically integrated internal R&D structures that were prevalent in many large companies in the second half of last century and in the early 2000's to a partnership or "consumption" model of innovation. Whether this is proving more successful requires more investigation.

Rio Tinto has gone down a similar track. In an interview for *Mining Technology Magazine* 15 years ago[6], the global head of innovation at Rio Tinto foreshadowed the trends in the following terms:

> R&D investment is distributed and operates in global technology markets, where multiple suppliers provide expertise and capability in networks and value chains. Rio Tinto is committed

[6] Rio and the Future of R&D, *Mining and Technology,* June 18 2008, https://www.mining-technology.com/features/feature2040/?cf-view

> to leveraging external centres of excellence in creating the 'mine of the future'. Undoubtedly, new alliances and structures will emerge as we pursue this vision.
>
> We have deliberately refrained from building large in-house centres to handle this new wave of innovation work. The world is increasingly interconnected and interdependent, and we believe our core skill lies in identifying the challenges, visioning the mine of the future, and coordinating the resources to best attack the problem. You should assume this will be our modus operandi going forward.
>
> I cannot speak for the rest of the mining industry in this regard, though I am aware that some of our competitors choose to pursue their own 'mine of the future' programs with predominantly in-house resources, while others seem more aligned with Rio Tinto's way of working.
>
> Whatever happens in the future, I am personally convinced that the wider network of mining houses, suppliers, research institutes and world-class universities will have to rise to the challenge we collectively face. Indeed, this will be an interesting time for our generation and, I suspect, for those who will come after us.

Comparison between the ASX and the EU listing data suggests that many companies have shifted their emphasis from "research" (the creation of knowledge) to "innovation" (the application of knowledge). Development sits in between on this spectrum. Many companies have gone down this track, with the result that reported R&D intensity using the OECD definition is slipping.

In summary, three trends are in play:

- Some companies, particularly in the pharmaceuticals sector, are continuing with a vertically integrated R&D process, from discovery through scientific research, clinical trials, distribution, and sales. This is an expensive process.
- In other sectors, the once-large centralised corporate R&D labs are disappearing, and R&D is becoming more distributed through a range of innovation sourcing strategies. This focuses more on the Development aspects of R&D.
- In other sectors companies are moving away from investing in R&D (the creation of knowledge) towards "Innovation" (the application of knowledge)[7], which is associated with very strong commercial metrics. Public policy/innovation policy has encouraged this.

The first category (develop/implement) spans both the "R" and "D" elements of the R&D spectrum. The second category is firmly at the "D" end. The third category relies on innovation—ideas successfully applied—to create new or improved products, processes, marketing methods, or business models. Ideas may or may not be generated through R&D[8].

Table 5 shows the R&D intensity for 500 global companies with a marketing, sales, and representative presence in Australia. From the reported R&D intensity, with R&D defined by the OECD framework, it is possible to hypothesise where different industries might be on the R&D spectrum. Of note in the context of the current discussion, Mining companies are classified to the Materials sector, with an R&D intensity of 0.4%.

Table 5: R&D intensity across industry groups for companies with a marketing/sales presence in Australia, 2022-23 ($A)

GICs industry group	R&D ($B)	Revenue ($B)	R&D intensity (%)
Pharmaceuticals,Biotechnology & Life Sciences	261.48	1,140.00	22.9%
Semiconductors & Semiconductor Equipment	146.57	973.47	15.1%
Software & Services	388.01	2,831.14	13.7%
Health Care Equipment & Services	74.44	634.44	11.7%
Consumer Services	136.70	1,292.17	10.6%
Media & Entertainment	222.11	2,143.42	10.4%
Technology Hardware & Equipment	32.58	563.92	5.8%

[7] That is, following Mark Dodgson's definition of innovation as "knowledge successfully applied".
[8] ABS The Business Longitudinal Study indicates that only a small proportion of innovation ideas come from R&D (*validate*)

GICs industry group	R&D ($B)	Revenue ($B)	R&D intensity (%)
Defence	40.69	865.85	4.7%
Automobiles & Components	89.06	2,123.23	4.2%
Capital Goods	39.69	987.51	4.0%
Household & Personal Products	7.62	318.63	2.4%
Commercial & Professional Services	2.08	225.61	0.9%
Telecommunication Services	10.57	1,235.54	0.9%
Consumer Staples Distribution & Retail	9.07	1,094.44	0.8%
Food, Beverage & Tobacco	11.67	1,384.41	0.8%
Energy	10.08	1,930.41	0.5%
Consumer Durables	0.82	228.63	0.4%
Materials	2.85	741.65	0.4%
Transportation	0.54	266.36	0.2%
Consumer Discretionary Distribution & Retail	...	...	0.0%
Financial Services	-	997.56	0.0%
Real Estate Management & Development	0.05	97.27	0.0%
Utilities	...	...	0.0%
Overall sample	*1,486.68*	*22,075.64*	*6.7%*

Table 4 shows that there are eight global pharmaceutical companies with marketing, sales and representational presence in Australia, but it is understood that very little R&D occurs in Australia. This is possibly the effect of the abolition of the Factor F Scheme which ran from 1987 to 1997[9].

For Australia's industrial future, more companies are needed to engage in "Real R"—that is, risk-taking, exploratory research where it might fail. Businesses need to invest in this sort of research if they are going to create new products and services rather than simply being fast-follower adopters.

Innovation sourcing comes with its own set of problems. Companies that source innovation externally can run into absorptive capacity due to the absence of experienced R&D managers who can interpret and apply ideas in an overall business context. There are numerous examples of where externally sourced R&D fails to get traction in implementation.

It is OK to "source" innovation, but if a company does not have the capacity to implement due to its previous hollowing-out strategies, there is a problem.

Implications for the business R&D scorecard

Even this very preliminary analysis has provided insights into the R&D expenditures of Australian-listed companies and overseas companies with marketing, sales, and distribution activities in Australia.

The information can serve as a focus for strategies to encourage overseas headquartered corporations to undertake more of their R&D in Australia.

The information also provides a base for getting a better understanding of R&D intensity. In particular, there is an apparent split between:

- Companies that develop technologies and use them in their business models
- Companies that simply adopt and apply technology

[9] The "Factor F" scheme was a policy to promote the pharmaceutical industry by encouraging local manufacturing and research. This scheme was part of a broader strategy to foster the growth of high-value-added industries in Australia. The primary aim of the scheme was to attract multinational pharmaceutical companies to invest in Australia, thus boosting local production, research, and development capabilities. The scheme was generally regarded as successful in terms of a significant increase in local production and R&D activities, contributing to the growth of the pharmaceutical industry in Australia during the late 1980s and early 1990s. The abandonment was due to cost, market-driven industry policy, and some doubt about its long-term effectiveness and sustainability.

This is in a context where the once-large corporate R&D labs are disappearing, and R&D is becoming more distributed and networked. This is part of a trend towards "unbundling" the corporation[10] and innovation sourcing[11].

Several of the nonpharmaceutical and biotech companies listed in Table 4 were once known for their research laboratories; they now have a very low level of R&D intensity, suggesting that they might be obtaining their R&D 'outcomes' from elsewhere. Particularly noticeable are the automotive companies.

Corporations source R&D in global technology markets, where multiple suppliers provide expertise and capability across global value chains[12]. They are moving towards being knowledge and technology integrators in regional, national, and global innovation ecosystems.

Further developments

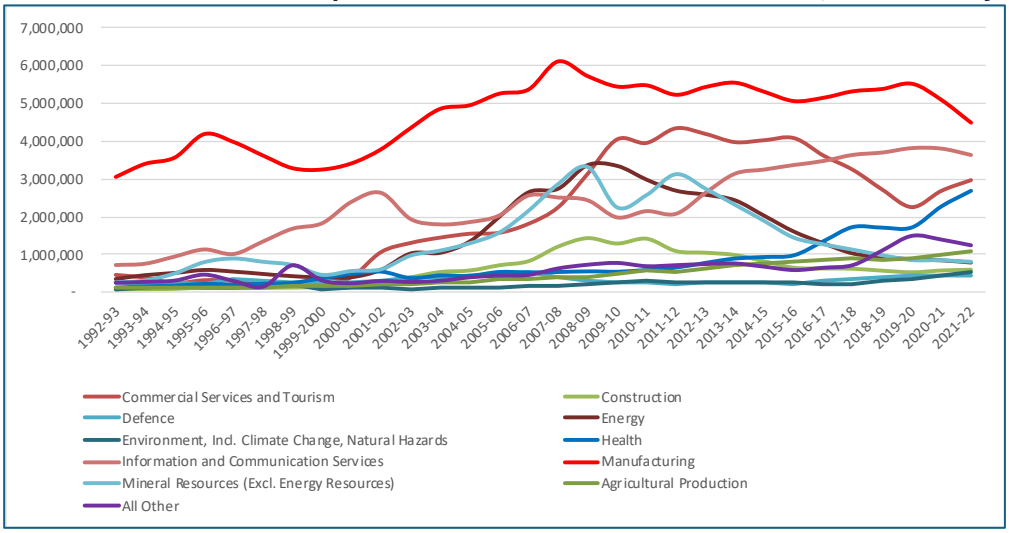
Further development of the scorecard would include identifying patents held by companies through the IPA Australia IP database. Information on R&D personnel might also be captured in annual reports. Information on location may also assist in identifying clustering effects.

For example, a casual inspection of information in annual reports indicates that many small R&D-intensive companies are located in suburban retail, commercial and light industrial zones.

What we know publicly is in Australian Innovation at the Crossroads, the consolidation of articles from @AuManufacturing.com. An extract follows.

The collapse in R&D expenditure has not been evenly spread across industry sectors.

Figure 1: Trends in business expenditure on R&D 1992-93 to 2021-22, inflation adjusted.



Source: ABS

The largest collapse has been in energy R&D (black line), principally by fossil fuel companies, and has not been compensated for by investments in alternative energy sources in Australia.

[10] Hagel, J., & Singer, M. 1999. Unbundling the Corporation. *McKinsey Quarterly*, 3(3).
[11] For example, see Howells, J., & James, A. 2001. Corporate Decision-Making on the Sourcing of Technological Knowledge, Discussion Paper Series. Manchester: PREST, Linder, J. C., Jarvenpaa, S., & Davenport, T. 2003a. Innovation Sourcing Matters, *Accenture Institute for Strategic Change*. Boston, Linder, J. C., Jarvenpaa, S., & Davenport, T. 2003b. Toward an Innovation Sourcing Strategy. *Sloan Management Review*, 44(4): 43-49.
[12] See, for eample Arora, A., Fosfuri, A., & Gambardella, A. 2001. *Markets for Technology: The Economics of Innovation and Corporate Strategy* (1st ed.): The MIT Press. Arora, A., Landau, R., & Rosenberg, N. 1999. Dynamics of Comparative Advantage in the Chemical Industry. In D. C. Mowery, & R. R. Nelson (Eds.), *Sources of Industrial Leadership: Studies of Seven Industries*. Cambridge: Cambridge University Press. Bresnahan, T. F., & Gambardella, A. 2004. *Building high-tech clusters : Silicon Valley and beyond*. Cambridge, UK ; New York: Cambridge University Press.
Leiblein, M. J., & Ziedonis, A. A. 2011. Technology strategy and innovation management. Cheltenham, UK ; Northampton, MA: Edward Elgar Pub.

These predominantly overseas-owned and newly formed companies invest heavily in alternative energy R&D, but not much in Australia.

There has also been a decline in mineral processing R&D (light blue line) since 2008, reportedly as mining companies moved away from exploration to concentrate on extraction, averting the need to develop new technologies[13]. But as argued above, they are undertaking R&D differently—through sourcing strategies, venture capital investments, and acquiring start-ups.

Australia is benefiting from the extraction of new economy minerals, such as lithium, but is not benefiting from R&D in their processing.

Increased R&D investment in Information and Communication services from 2012-13 (light brown line), but a decline in commercial services and tourism since 2015-16 (dark brown line), although this has been recovering since 2019-20.

The downward trend in manufacturing R&D since 2020-21 is concerning, but COVID-19 might have influenced it. There is currently a concerted effort to build capability in advanced manufacturing through R&D investment in sensors and data analytics, advanced materials, smart robotics and automation, additive manufacturing (3D printing), and augmented and virtual reality[14].

Defence R&D does not take on the significance it does in the US and many other countries.

R&D in the Construction, Environment, and Agricultural production industry subsectors has been small. Again, global corporations invest heavily in R&D, but not much is undertaken in Australia.

Without the rapid growth in health R&D (mainly due to CSL), the situation would be even direr.

But, apart from the EU Industrial R&D Investment Scoreboard, and what can be gleaned from ASX and other listing information, we have very little systematic knowledge of R&D performance of companies investing in R&D in Australia. While we know about trends at the industry level, we have very little knowledge of which companies have leading roles and impacts in R&D investments.

We have even less information about what and how much individual Australian companies are investing in the more broadly defined "innovation" category—apart from the 10 companies included in the top 2,500 EU Scoreboard collection (See Table 1).

[13] AlpaBeta, 2020. *Australian Business Investment in Innovation: Levels, trends and drivers*. A report prepared for the Office of Innovation and Science Australia. https://www.industry.gov.au/sites/default/files/2020-02/australian-business-investment-in-innovation-levels-trends-and-drivers.pdf

[14] CSIRO Futures, 2016. Australian Manufacturing: A Roadmap for unlocking future growth opportunities for Australia, CVSIRO, Canberra, Chapter 5. https://www.csiro.au/en/work-with-us/industries/manufacturing/advanced-manufacturing-roadmap

Attachment 1: ASX listed companies reporting R&D Expenditure in 2022-23

Available on request

Attachment 2: Global technology-intensive companies with a marketing, sales and distribution presence in Australia

A list drawn from a profile of 475 global companies which report R&D in their financial statements and which undertake marketing, sales and distribution activities in Australia. As observed earlier in this paper, very little of this R&D is undertaken in Australia.

The data draws mainly on NYSE and NASDAQ listings, even though a company may be headquartered in another country. European companies, particularly that do not list on these exchanges, are not included in the data analysis below.

Data available on request