South Australian Productivity Commission

Draft Report

Turning Research into Economic Competitiveness for South Australia

16 March 2023

Government of South Australia

Disclaimer

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The Hon Peter Malinauskas MP
Premier of South Australia
State Administration Centre
200 Victoria Square
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Dear Premier

SAPC Inquiry – Turning Research into Economic Competitiveness for South Australia

In accordance with the terms of reference received by the Commission on 13 December 2022, I am now pleased to release the South Australian Productivity Commission's Draft Report on our inquiry into Turning Research into Economic Competitiveness for South Australia for public comment.

The Commission's central purpose is to provide you with independent evidence based economic advice on how to improve our State's economic growth and in turn, South Australian household incomes.

Owing to time constraints this report is less fully developed than would normally be the case, and we will be embarking on an intense period of stakeholder consultations to refine it and test its initial conclusions. Nonetheless we have reached a number of significant findings:

- Poor innovation performance, particularly in South Australian businesses, is largely responsible for the state's weak growth over the past decades. If we had been able to keep pace with global technological change over the past two decades then the average South Australian full time worker would be earning $8,000 more than they are today.
- South Australia is at the edge of some potentially very significant economic opportunities, particularly from the AUKUS submarine build and from the state's potential to contribute to the global green energy transition.
- However, the weakness in our state's innovation performance has not just held back incomes and jobs growth over the past decades. It also represents a barrier to South Australian's fully realising the benefits of the emerging opportunities.
- In response we have developed a draft reform package focused around how the state's universities engage with business around innovation, to better align incentives and build common understandings and approaches.
- These reforms have the potential to transform the state's economy delivering high-skill, high wage jobs for many more South Australians. As with all proposed microeconomic reform there will be understandable debate. We are looking forward to working with stakeholders over the next two months to improve our proposals.
- I take this opportunity to thank my hard-working colleague Mr Steve Whetton and our inquiry team for their high quality assistance on this important assignment.

Yours faithfully

Adrian Tembel
CHAIRMAN

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Inquiry team

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Key messages

South Australia's economic performance has been poor

South Australia's economy has been underperforming over the past three decades, with slower growth and lower wages than our peers in the eastern states.

South Australia's economy is currently performing strongly coming out of COVID-19, but the current strength appears to be cyclical not the start of an upwards structural trend. The longer-term picture is of a state stuck in a low growth trajectory, falling behind the eastern states in incomes.

Annual average growth in GSP over the past three decades has been 2.1 per cent. And our long-term structural growth trend is not positive with the 2010s being the worst decade with growth averaging only 1.0 per cent.

This prolonged period of weak economic growth impacts on people's daily lives. Wages have declined relative to the rest of the country, with both private and public sector wages 8 per cent below the national average.

Falls in high value-add exports also suggest an economy that is lacking in economic complexity and becoming less internationally competitive outside of commodities.

As well as being low growth, the South Australian economy shows little evidence of being internationally competitive outside of commodities. Exports are almost all in commodities and basic metals.

High value-added, complex, goods and services exports have actually **fallen** by over $1 billion in real terms over the last decade. This is despite the relevant sectors having been a significant focus of SA Government innovation and trade policy support.

Productivity growth is key to high incomes and high-quality jobs, but SA has been underperforming

Increased productivity is crucial to increasing prosperity.

Increasing productivity increases the competitiveness of local businesses, allowing them to grow and their employees to earn higher wages. Unfortunately, South Australia has had weak productivity growth, particularly over the last decade. This has been the main factor behind our weak overall economic growth, and for wages falling behind the rest of the country.

This is not about working harder, but working more effectively, and having more South Australians working in high value jobs.

Improving productivity by doing a better job of keeping pace with the global frontier of technology and knowledge is not the type of reform that requires South Australians to work more to secure the benefits, or which needs widespread job cuts to increase efficiency.

Instead, technological change and knowledge improvement allows existing firms to create more value with their workers and equipment. And it will lead to more South Australia's having jobs that are high skill, paying high wages.

If South Australia had been able to innovate enough to keep pace with the long-run growth of global knowledge over the past 20 years, our incomes would be much higher.

If South Australia had been able to keep pace with the average global growth in technology and knowledge over the past 20 years, annual growth in output per person would have been 1 percentage point faster. This would have given us per capita output on par with New South Wales.

If South Australia had been able to reach New South Wales' productivity, the average South Australian full-time worker would be earning $8,000 more per year.

This inquiry's aim is to identify how to deliver more high-growth, innovative firms and more South Australians in highly skilled, highly paid jobs by reforming university business links

This inquiry is seeking to improve how well our innovation system supports South Australian jobs and incomes, by investigating how research is turned into increased competitiveness for South Australia.

This inquiry will support the South Australian Government's policy development around addressing the state's productivity challenge by undertaking a forensic examination in ***how research is turned into increased competitiveness*** for our state, including:

- the importance of research and knowledge diffusion for economic competitiveness;
- the effectiveness of current links between research institutions (including universities) and business, and of government programs supporting research and innovation; and
- what the State Government can do (including in collaboration with others) to help bridge the gap between the generation of knowledge and those who could put it to use.

The right policy settings right in this area can make a significant contribution to closing the productivity growth and income gap with the rest of Australia, to increase the complexity and diversity of the state's economy, and to reduce the risks of excess dependence on our agricultural and mining sectors for our international competitiveness.

The goal is to significantly increase the number of South Australians who are employed in high-skill, high-wage jobs; jobs which are more secure because they are innovating with the global economy rather than at the mercy of international economic trends.

Improving the connection between knowledge generated in our universities, and businesses who can convert it into economic value, is also important to ensure South Australia can fully realise the benefits of its emerging opportunities such as those arising from the AUKUS submarines project and from the green energy transition.

But this will require us to fix the state's poor innovation performance

South Australia's business sector is smaller, less dynamic and is less likely to be high-growth than businesses in the eastern states.

South Australian businesses are generally very small, and the business sector is much less dynamic that those in the eastern states, with fewer entries and exits.

They are also much less likely to be high-growth, and this is true across industry sectors

South Australian business innovation is also low.

South Australian firms invest much less in R&D than those interstate and are less likely to patent innovations.

South Australian firms tend to be 'inward looking' in their innovation, with a particularly low likelihood to draw on universities as a source of ideas.

South Australia has significantly fewer workers in innovation jobs

South Australia has a below average share of 'innovation occupations'. As a result the capacity in the state to both produce and implement new ideas, as well as capture existing technology, is diminished.

If we were even able to reach the national average, there would be 7,000 more South Australians employed as scientists, computer programmers, and engineers today.

If we were to achieve the concentration of workers in innovation seen in NSW or Victoria there would be 10,000 more South Australians employed in these occupations.

South Australia has innovation workforce strengths in agriculture, food, agribusiness, and electronics. However, there are significant gaps in the share of some other types of innovation jobs particularly in information and communications technology (ICT), cyber security, and programming occupations.

Universities have some significant areas of research strength, but links to industrial outcomes are weaker limiting the economic value created from this research strength

South Australia's three research universities – Flinders University, the University of Adelaide, and the University of South Australia – are the state's most significant research institutions. Between them they host 66,383 undergraduate students, 25,620 post-graduate students and employ 3,930 academic staff. [1]

The revenue of South Australia's universities, and therefore the incentives that they face, is largely driven by student income.

Each of South Australia's universities has areas of world class research strength. And a number of these strengths map well to key economic priorities for the state such as the green energy transition, and the defence sector.

University-business collaborations are not a strength of the state's economy. South Australian businesses are very inward looking in terms of sourcing ideas for innovation, with only 3 per cent of South Australian innovation active firms identifying universities as a source of ideas, and only 1 per cent collaborating with a university on innovation.

It is also concerning to note that university funding outcomes in South Australia have been weakest in those schemes aimed at supporting early career researchers, creating a risk to our longer-term research capabilities.

SA Government innovation and trade policy shows no evidence of overall effectiveness, and may be spread too thin

The supports currently offered by the SA Government can be broadly characterised as having significant breadth, but as a consequence many of the individual interventions have relatively limited resources allocated to them. This can also make the funding system harder to navigate for businesses or researchers seeking support.

[1] In addition to its research universities, South Australia also has a number of substantial public research institutions. Some of these such as SAHMRI are South Australian specific, some are local nodes of national bodies. In most cases through the report the use of the word universities should be taken to also encompass the public research institutes.

The persistent weakness of business innovation in South Australia suggests that the current set of policies as a whole have not been effective.

We also note that our analysis of the international literature has not shown evidence that precincts are an important tool for innovation policy. Instead the literature emphasises investing in people, in their skills, and in aligning their incentives.

That is not to say that all of the individual policies have been ineffective, there may well be interventions that have delivered meaningful impacts. As we consult on the draft report, we are looking forward to exploring the evidence on the relative effectiveness of specific existing programs with key stakeholders to ensure it is reflected in our findings.

Evidence shows that innovation talent, alignment of incentives, and improving mutual understanding between universities and business is the key to productive innovation enhancing collaboration. No evidence that buildings should be a major focus.

People, and their ability to transmit tacit knowledge, are the reason university research can drive business sector innovation and wages growth. This means that **talent** is the key to university business collaboration. Talented people, rather than precinct development, need to be the focus of future innovation policy.

The international evidence also highlights the importance of fostering common understandings and a common language between universities and business, and of ensuring that incentives are aligned between universities, their researchers, and businesses.

The role of universities in driving innovation is not purely a STEMM story with significant commercialisation potential in non-STEMM fields. Entrepreneurial skills are just as important to research commercialisation as technical skills. Building entrepreneurial education and experiences into the post-graduate curriculum across faculties, is likely to be an important enabler of economic impact from research.

Given South Australia's specific circumstances, intermediaries between universities and business should be focused on actually undertaking applied business focused research.

Internationally, a number of models have been adopted for intermediary bodies established to improve the connections between the research sector and business. Our assessment of the evidence is that research delivery focused approaches, such as the German Fraunhofer Gesellschaft, the UK Catapult network and the Canadian Technology Access Centres appear best suited to bridging the gap between universities and business in South Australia.

Given where South Australia is now, we need to focus on the 'supply' side of innovation – Universities

Our conclusion based on the evidence we have collected to date, is that for the state to realise its potential we need to make universities and their connections to industry the engine of our transition to a dynamic, complex, economy.

This is not because the only barriers to engagement exist at the university side of the relationship, but rather because our assessment is that at this stage, the barriers at the university level can be more effectively addressed.

If it is working well, links between universities and business to support innovation can:

- help existing, innovation intensive firms innovate even more successfully and grow even faster,

- help existing firms that have the potential to make the shift to being high growth innovative firms, and
- create more innovation intensive/high-growth firms in the state by increasing the rate of start-ups, increase the chance that start-ups will be able to scale up in South Australia, and help attract innovative firms into the state.

However, there are a number of barriers to achieving international good practice in the relationship between universities and the business community.

These barriers exist at the both the supply side (universities and other research institutions) and at the demand side (businesses). However, given the relatively low level of private sector R&D, the extent to which firms are focussing on incremental, inward-looking innovation, and the predominance of very small firms in the state our conclusion is that South Australia will need to first look to our universities to drive innovation. This means policy focus should be on fixing the supply side.

University merger as a potential driver of cultural change

The Commission's current inquiry in early 2023 is being undertaken against the backdrop of South Australian Government facilitated discussions about a potential merger between the University of Adelaide and the University of South Australia.

The potential implications to a university merger were not included in the Commission's terms of reference for this inquiry and so the Commission is unable to form a view on the relative merits of a merger.

However, we would note that a merger, if designed and implemented competently, could create a catalyst for broader cultural change in the merged institution making some of our suggested reforms more likely to succeed. The merger could also potentially create cost savings for example through removing duplications of assets enabling more efficient use of facilities. If any such savings were used to fund applied, industry focused, research in the spirit of our reforms then the potential for the universities to drive improvement in the state's economy would be further enhanced.

Universities need to implement reforms, and to be supported in doing so through investment in innovation.

Our conclusion based on the evidence presented in this draft report is that reform is required amongst the universities to position them to fulfil their potential as the engines of South Australian innovation.

In order for universities to fulfil their potential as drivers of innovation in the economy we must address the human factors that reduce the effectiveness of university business collaborations. International evidence shows that it is particularly important to:

- improve the alignment of incentives between researchers and businesses;
- foster common understanding and knowledge between researchers and business people, including helping them to "speak one another's' language"; and
- deepen personal alignment, through establishing similarities of workplace cultures and norms, and by fostering social connections between researchers and business people.

Each of our suggested reforms are targeted at supporting one or more of these factors.

1. Reform IP ownership and inventor incentives

Successful commercialisation of research through a start-up requires significant on-going involvement from the inventor(s). The equity shares currently taken by South Australian universities risk diluting the incentive for on-going participation by inventors.

Adopting a lower default equity share for universities could increase the number of start-ups created and increase their chance of scaling-up and securing venture capital funding.

Reform is also required in the speed and simplicity of contractual arrangements for getting research out where it can create economic value.

2. Make impact and engagement one of the central statutory objectives of our universities

Internationally, discussions about the role of universities are increasingly referencing a tripartite focus on teaching, research and engagement as part of their 'social license'.

Existing statements of objects and purpose for South Australian universities emphasise the traditional dual teaching and research role of the institutions. A number of leading international institutions have objects that encompass a broader set of impacts, and these could serve as models for amendments to the relevant Acts to properly reflect the Universities' social license obligation to the South Australian economy and households.

3. Ensure academics can get recognition for engagement

The South Australian Government should encourage the other universities to adopt the University of South Australia's approach of allowing academics to choose between research quality and engagement performance indicators, giving engagement focused academics a clear route to promotion.

The three universities should also be supported to revise their workload models so that industry engagement can be sufficiently resourced.

4. Build and reward entrepreneurial skills across university students

Each of South Australia three universities deliver entrepreneurship education. However, they need to find a way to take the high-quality existing teaching practice around entrepreneurship (and entrepreneurship competitions currently run on a relatively small scale) and make them much more extensive.

The ultimate goal should be that every higher degree by research student, regardless of faculty. should receive entrepreneurship training as part of their program. And that these courses should be taught across faculties allowing students to build connections with one another.

Achieving these ambitions will require a long-term, substantial investment in innovation from the State and Commonwealth Governments, and from the universities. But this investment should be conditional on reforms being achieved.

5. Establish Critical Technology Applied Research Institutes as a new model for joint research and knowledge sharing with industry

South Australia needs a new model for translating research from universities to industry. International evidence suggest that this is best done by funding research undertaken with industry targeted at addressing key business problems. This is not, and should not be, a 'marketing' focused intermediary.

The proposed model is based around applied researchers specifically employed to jointly design and deliver research with industry partners to address their problems using critical technologies. These centres would also expand early career opportunities for applied researchers in the state, retaining more of our young talent, and improve industry understandings of the potential uses of critical technologies.

6. Establishing a reform fund to support universities in implementing the changes.

In order to support universities in implementing the above recommended reforms, it would be reasonable to provide them with targeted financial support conditional on agreed reforms having been implemented. This could include co-investment support for providing 'seed' funds to start-ups commercialising university IP, or support for early career researchers.

This is a policy reform, not an aid package.

The model for this would be the national competition policy (the Hilmer reforms) delivered under the Keating Government in the 1990s, where state governments were provided with additional Commonwealth government funding in exchange for successfully implementing reforms aimed at increasing the competitiveness of the Australian economy.

Funding should be allocated in a way that minimises bureaucracy and makes use of existing structures, and with co-investment from the universities.

Funding would only be released on achievement of agreed reforms. Essentially the funding would be targeted at activities that help deepen the role of the universities in South Australian innovation.

Increased access to people with entrepreneurial skills will help these reforms succeed.

Access to global entrepreneurial talent, particularly international students in South Australia who already have a connection here, makes it more likely that the state will be able to successfully build a more innovative, complex economy.

International students provide an underutilised pool of potential entrepreneurial ideas and skills for South Australia. As a state we should be doing all we can to support them in commercialising their ideas here in South Australia. But to do so will require Commonwealth Government support to make the 188E visa more effective at retaining international students and attracting inward migrants with plans to develop start-ups. And the state will need a larger allocation of places and more timely processing of applications.

About the South Australian Productivity Commission

The Commission's central purpose is to provide the Premier with independent evidence based economic advice on how to improve our State's economic growth and in turn, South Australian household incomes.

Premier and Cabinet Circular, *The South Australian Productivity Commission* (PC046) sets out the objectives and functions of the Commission; how inquiries are referred to the Commission, undertaken and reported on; and how the Commission and public sector agencies work together.

The Commission is supported by the Office of the South Australian Productivity Commission which is an attached office of the Department of the Premier and Cabinet.

Commission's approach

The Commission is required to take a broad perspective in developing advice for the South Australian Government. It must consider the interests of industry, business, consumers and the community, regional South Australia, social-economic implications and ecological sustainability.

The Commission conducts its own independent quantitative and qualitative analysis. It also draws on the experience, evidence and views of all inquiry stakeholders.

The release of this draft report supports interested parties to participate in the inquiry by highlighting the key issues and by raising questions to generate feedback.

It is important to emphasise that the Commission has no predetermined views on the matters covered by the inquiry. This draft report sets out the Commission's initial understanding of the relevant matters. Feedback from stakeholders will assist further analysis and review that will contribute to the development of the final report.

Making a submission

The Commission invites submissions on the draft report by 14 April 2023. Submissions may address any of the issues covered by the paper and the terms of reference.

Submissions are also accepted from South Australian Government agencies if approved by their Chief Executive.

An electronic submission in Word or PDF format is preferred, along with any supporting documentation containing facts, figures, data or examples:

- through our website www.sapc.sa.gov.au; or
- via email at sapc@sa.gov.au; or
- via post at: GPO Box 2343, ADELAIDE SA 5001.

Key dates

13 December 2022
Notice of inquiry

February and March 2023
Initial public consultation

16 March 2023
Draft report published

Draft report public consultation

14 April 2023
Submissions due on draft report

12 May 2023
Final report presented to the Premier

10 August 2023
Final report made public

Confidentiality

Transparency is an important part of the Commission's independent process for gathering evidence and other elements of the inquiry process. The Commission will publish the submissions that it receives on its website unless the author clearly indicates that the submission is confidential or the

Commission considers the material to be offensive, potentially defamatory, beyond the scope of the inquiry's terms of reference, or an abuse of process.

Disclosure

The Commissioners have declared to the South Australian Government all personal interests that could have a bearing on current and future work. The Commissioners confirm their belief that they have no personal conflicts in regard to this inquiry.

Adrian Tembel is the Chief Executive Partner of Thomson Geer, a major Australian law firm which represents a broad range of clients throughout Australia.

Christopher Findlay is an investor in a trust that provides early stage investment to South Australian start-ups.

More information

For more information on the Commission, including circular PC046, how to communicate with the Commission and details on the Commission's approach to handling confidential material visit our website at www.sapc.sa.gov.au, email to sapc@sa.gov.au or call 08 8226 7828.

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Findings

Finding 1: South Australia has experienced economic growth well below the national average over the past three decades, and that has had a material impact on the incomes of South Australian households.

Finding 2: The notable decline in the real value of high value-add exports from South Australia suggests that businesses in these sectors are becoming less internationally competitive.

Finding 3: South Australia's productivity growth has been poor over the past decade, and this is an important factor in the weak economic growth over the same period.

Finding 4: International evidence shows that the spillovers from research, development and innovation are one of the most important drivers of economic growth

Finding 5: Most net jobs growth, and most job creating innovation in Australia occurs in high growth firms.

Finding 6: Policy aimed at stimulating economic growth through encouraging business innovation should be targeted at enabling high-growth firm (including firms with the potential to become high-growth).

Finding 7: South Australia's business is much less dynamic than the national average (with both lower entry and exit rates). This, and smaller average size of businesses, reduces business innovation and so it is likely that there is less scope for business innovation amongst the current SA business community than the eastern States

Finding 8: South Australian businesses are less than half as likely to be 'high growth firms' than the national average.

Finding 9: South Australia's low rate of high-growth firms is not primarily a result of the state's industry structure but is evident in every industry sector.

Finding 10: South Australian firms invest less than the national average in R&D and this gap has been widening.

Finding 11: South Australian businesses are very inward looking in terms of sourcing ideas for innovation, with only 3 per cent of South Australian innovation active firms identifying universities as a source of ideas, and only 1 per cent collaborating with a university on innovation.

Finding 12: South Australian has a large number of innovation programs, but most are small and have limited funding.

Finding 13: The revenue of South Australia's universities, and therefore the incentives that they face, is largely driven by student income.

Finding 14: South Australia has a number of areas of world class research strength. And a number of these research areas map well to key economic priorities for the state such as the green energy transition, and the defence sector.

Finding 15: South Australia has a strong workforce in many key innovation occupations linked to state priorities. The general exception is in IT occupations, particularly cyber security, where the state's share of national employment is well below its population share.

Finding 16: International evidence suggests that whilst geographical proximity is important to university-business links around research and innovation, geographical proximity in this context means being located within 25 to 30 km, not co-location.

Finding 17: Proximity – understood broadly to encompass similar values, norms and technological understanding as well as geographic closeness – is the most important factor in successful business industry collaborations.

Finding 18: Innovation at its heart is about talented people, and talented people rather than buildings need to be the focus of future innovation policy.

Finding 19: Successful commercialisation of research doesn't only depend on great science or engineering, it also needs a range of non-STEM skills.

Finding 20: Research focused models of intermediation aimed at building proximity between research and business, such as the Fraunhofer Gesellschaft, the UK Catapult network and the Canadian Technology Access Centres appear most likely to address the limitations identified in South Australia's innovation activity.

Finding 21: Our conclusion based on the evidence presented in this draft report is that reform is required amongst the universities to position them to fulfil their potential as the engines of South Australia's innovation system

Finding 22: Implementing these suggested reforms would not be costless for the universities, and whilst we believe they would deliver benefits for the universities, the lion's share of the benefits will flow to the state more broadly. This means that it may be reasonable for the universities to be provided with financial support to facilitate the reforms being requested.

This funding should only be disbursed on agreed progress towards implementing the reforms.

Finding 23: South Australian universities' default equity shares appear to be too high, and adopting a lower standard share could increase rates of scale-up and VC funding for start-ups with university researchers as founders.

Finding 24: None of the three South Australian universities have economic or social impacts in the state included as part of their purpose and objects under the relevant Acts.

Finding 25: The South Australian Government should encourage the other universities to adopt the University of South Australia's approach of allowing academics to choose between research quality and engagement performance indicators. The three universities should also be supported to revise their workload models so that industry engagement can be sufficiently resourced.

Finding 26: Entrepreneurship education should be provided as a compulsory subject in higher degree by research courses in South Australia. Similar courses should be offered as options to undergraduates across all faculties.

Finding 27: South Australia needs a network of dedicated, technology specific, applied research institutes to help bridge the gap between universities and business.

Finding 28: Financial support to the SA universities to facilitate implementation of the suggested reforms should be tied to activities linked to university-industry collaboration and released in a way that minimises administrative burden.

Finding 29: The South Australian Government should work with the Commonwealth Government to secure a higher allocation of 188E visa places for the state, and to achieve more timely processing of 188E visa applications.

Information requests

The Commission is interested in receiving evidence-based feedback from the relevant stakeholders on a number of issues that have arisen in the preparation of the draft report. Whilst we are keen to hear any feedback from stakeholders that they feel is relevant, we are particularly interested in testing our initial views on:

Resourcing of SA Government programs

Does the current model of offering a wide range of programs around research and innovation, and as a consequence reducing the average level of resources per program suits the state's needs? Or would it be better to move to a model of significantly fewer programs, but each with more substantial resourcing?

Research strengths

What are the most reliable approaches to identifying areas of research strength in South Australia relative to our key international peers, and any available analysis on what those areas of relative strength may be?

Potential for research industry collaboration

What the areas of current strength in research-industry collaboration in South Australia, and what approaches could be used to identify areas that do not currently strong research-industry collaboration, but have with the *potential* to do so?

Relative employment share of research occupations

Does the relative employment shares in research occupations represent a useful indicator of relative strengths and weaknesses for the state around business innovation?

Providing universities with incentives to reform

What types of incentives and support to universities would be most compatible with engaging them in the reforms canvassed in this report?

University equity shares in start-ups

Do the current standard equity share taken by South Australian universities in start-ups commercialising IP developed at the university reduce the incentives for researchers to participate in the commercialisation of research? And does it reduce the willingness of venture capital funds to invest in these start-ups?

Objects and functions of South Australian universities

Would expanding the objects and functions of each of the South Australian universities in their relevant Acts be a useful way of embedding a broader focus on contributions to industrial outcomes as part of their 'social license', or would it make little practical difference?

Providing academics with recognition for engagement

Is the proposed model outlined where academics could choose a set of KPIs focused on engagement or on research quality based on their specific interest a workable model for supporting those academics who wish to prioritise industry engagement, whilst not reducing the incentives for research quality across the university?

Entrepreneurship education and support

Would it be feasible to extend the delivery of entrepreneurship education to all higher degree by research students in South Australia? And if feasible, is such an increase in entrepreneurship education likely to lead to a large enough increase in entrepreneurial activity by students to make it worthwhile?

Critical Technology Applied Research Institutes as a model for facilitating technology transfer out of universities

Is the draft model outlined in this report for a new set of applied research centres aimed at facilitating university-business links in critical technology areas likely to be an effective approach? Or are there elements of the local innovation system that suggest this type of model is unlikely to be effective?

Financial support for universities to facilitate reforms

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether the proposed funding allocation model and funding priorities would be workable?

Importance of entrepreneurs as a target for migration

Should entrepreneurs be a high priority for state-sponsored migration? And in particular, should international students studying in South Australia and who have an entrepreneurial idea they want to develop be a focus for state-sponsored places in the entrepreneurship visa category?

Acknowledgements

The South Australian Productivity Commission would like to acknowledge the assistance of all of those who contributed to the development of this draft report through consultations or through the provision of data. In particular, we acknowledge the productive engagement we have received from Flinders University, the University of Adelaide and the University of South Australia.

The Commission would like to thank the South Australian Department for Industry, Innovation, and Science, for providing range of relevant background information, briefings and program documents. We also acknowledge the South Australian Department for Trade and Investment, and the South Australian Department of the Premier and Cabinet for providing a range of program documents.

Data analysis was commissioned for this report from the SA Centre for Economic Studies at the University of Adelaide.

Acronyms and Definitions

Accelerator	A training and support program designed to help a start-up increase its scale quickly, for example by providing its owner with better skills and networks around accessing finance, validating and prototyping business ideas etc.
ARC	The Australian Research Council (ARC) is the Commonwealth Government's principal funder of non-medical research. Funding is allocated through a range of specific schemes using a peer review process.
Business innovation	A business innovation is a new or improved product, business process, *or* business model (or a combination thereof) that differs significantly from the firm's previous products, processes, or business models that has been introduced on the market or brought into use by the firm.[2]
Commercialisation	The means of delivering research benefits to the community and creating economic benefits through the commercial process of converting science and technology, new research or an invention into a marketable product.
High growth firm	A firm with average annualised growth rates in turnover and/or employment of more than 20 per cent, sustained for at least a three-year period.[3]
ICT	Information and Communication Technology.
Incubator	Incubators are a space (typically physical although they can be virtual) in which a start-up can locate and access a range of specially designed supports whilst developing its business idea
Intellectual property:	Intellectual property (IP) is the result of someone, or an entity (for example, a company), using their individual or collective minds and intellect to create an invention, design, method or process that is deemed to be novel or original.4
MRFF:	Medical Research Future Fund, a relatively recent Commonwealth Government scheme for supporting health and medical research.
NCRIS:	The National Collaborative Research Infrastructure Strategy is a Commonwealth Government funding scheme that supports priority large-scale collaborative research infrastructure, which is expected to be available for use by researchers from universities, public research institutes, and business.
NHMRC:	The National Health and Medical Research Council (NHMRC) is the Commonwealth Government's principal funder of health and medical research. It allocates funding through a range of schemes using a peer review process.
OECD:	Organisation for Economic Cooperation and Development

[2] OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities*, Paris: OECD Publishing/Luxembourg: Eurostat
[3] *Ibid*
[4] For more information, see https://www.turnbullhill.com.au/articles/intellectual-property-in-australia-explained/.

Patent	A patent is a right that is granted for any device, substance, method or process that is new, inventive and useful. It is a legally enforceable right to commercially exploit the invention for the life of the patent.
Productivity	Productivity refers to the combined effect of the use of inputs in a production process to produce valuable output. It reflects both the technology (i.e., the available knowledge about how inputs can be used to produce output), and the efficiency (i.e., determined by how inputs and technology are actually used) in producing output. Productivity is typically expressed in terms of Labour Productivity – the output produced for a given input of labour, or multi-factor productivity – the output produced for a given set of capital and labour.
R&D	Research and Development (R&D) is activity carried out to generate new knowledge, irrespective of its purpose, which could be economic benefit, addressing societal challenges or simply having the knowledge itself.[5]
Seed funding	seed funding is a form of equity funding provided to start-ups at an early stage when their scale is too small to make accessing venture capital feasible.
Spillovers	Spillovers refer to benefits from research and development experienced by individuals or organisations other than those conducting the R&D.
STEM	Science, technology, engineering and mathematics.
STEMM	A slightly broader grouping of knowledge than STEM, also incorporating medicine.
Start-up	A **start-up is** new firm established specifically to commercialise new technology or knowledge, such as new product or service or a new business process. As a start-up increases in size and moves towards focusing on addressing its market (rather than developing its product) it is often referred to as a **scale-up**. Where a start-up has been launched by a research institution to commercialise technology developed in the institution it is often referred to as a **spin-out.**
Tacit knowledge	Tacit knowledge is knowledge required to use an innovation which is only be available in the minds of people who use it. This is contrasted with codified knowledge which is knowledge that is easy to communicate to new users such as through a product manual.
TRL:	Technology readiness level (TRL), an approach to classifying the commercial readiness of a potential product or service, typically into 9 stages.[6]

TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Basic principles observed (basic research)	Technology concept formulated (applied research)	First assessment – feasibility concept & technologies	Validation – integrated prototype in lab environment	Testing prototype in user environment	Pre-production product	Low scale pilot production demonstrated	Manufacturing fully tested, validated & quantified	Production & product fully operational
← Invention →		← Concept validation →		← Prototyping & incubation →	← Pilot production & demonstration →		← Initial market introduction →	← Market expansion →

[5] OECD (2015), *Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities – the Frascati Manual*, Paris: OECD Publishing.
[6] European Association of Research and Technology Organisations EARTO (2014), 'The TRL Scale as a Research & Innovation Policy Tool, EARTO Recommendations'

Venture capital	is a form of private equity funding that is provided to start-ups and emerging firms perceived by the investors as having high growth potential, in exchange for an equity stake in the firm.

1. Background

1.1 South Australia's economic challenge

Our economy is currently performing strongly coming out of COVID-19…

South Australia is currently enjoying a strong economy coming out of the COVID 19 pandemic, with growth in economic output well above its long-run average. Unemployment at 4.0 per cent (as at Dec. 2022) is lower than it has been since the mid-1970s, though still above the national average.

There is also considerable potential upside, on which the current SA economic strategy is focused:

- 'green minerals', driven by commodity prices and the demands of decarbonisation;
- increased defence spending linked to the geopolitical context; and
- the scope to capture a share of the potential international trade in green hydrogen, driven by the global response to climate change.

but the current strong growth appears to be cyclical not the start of a significantly improved structural trend.

It could, of course, be the case that the two years of strong growth coming out of COVID-19 mark a shift in the economic position of the state. However, SA has had single high-growth years before which failed to convert to sustained growth. And data suggests that this current upturn is driven by cyclical factors and national conditions, with strong consumer spending and strong government spending (essentially residual stimulus from COVID) being particularly important. There are no current signs of a change in the industry mix, in the nature or scale of non-commodity exports, or degree of innovation in SA which might suggest structural barriers to growth had been addressed and that the recent strength represented a change in the long-run trend.

The longer-term picture is a state stuck in a low growth trajectory, falling behind the eastern states in incomes.

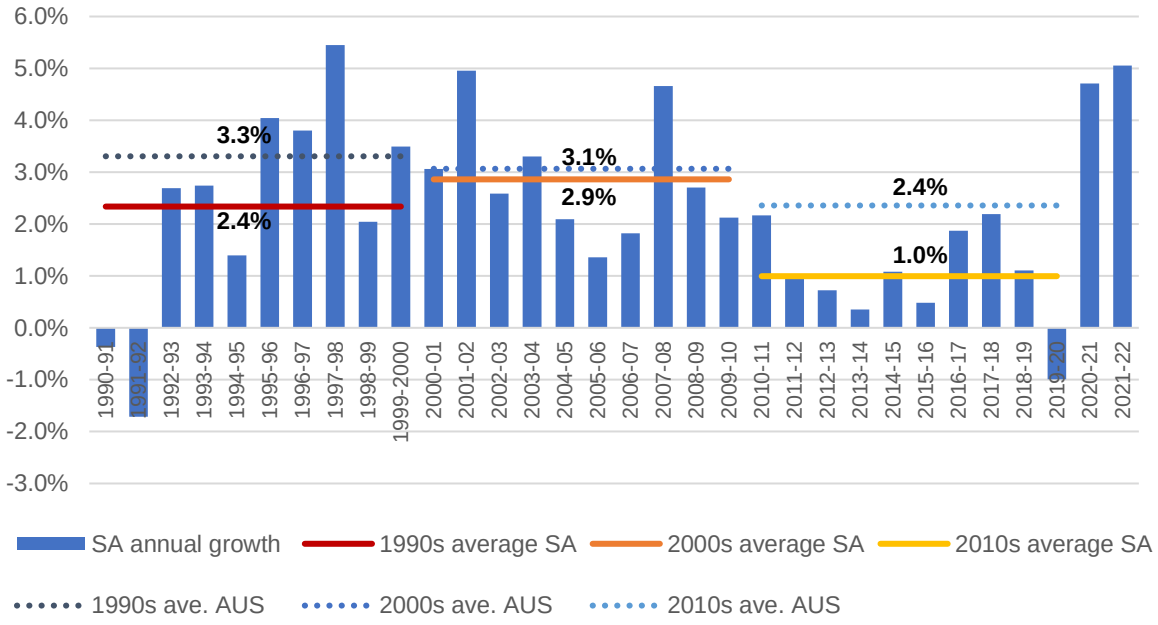
The longer-term economic performance of the state has been much weaker, with the lowest economic output per capita of the mainland states. In 2021-22 economic output per person was just under $15,000 below the national average.

Annual average growth in GSP over the past three decades has been 2.1 per cent. And our long-term structural growth trend is not positive (see Figure 1). Looking across the last three decades it is not the "State Bank decade" of the 1990s that is weighing the average down. In fact, it's the 2010s that was the worst, averaging only 1.0 per cent.

Without competitive growth, it much harder for our state government to match the quality of education, hospital and law and order services delivered by other States with a stronger tax base.

Finding 1: South Australia has experienced economic growth well below the national average over the past three decades, and that has had a material impact on the incomes of South Australian households.

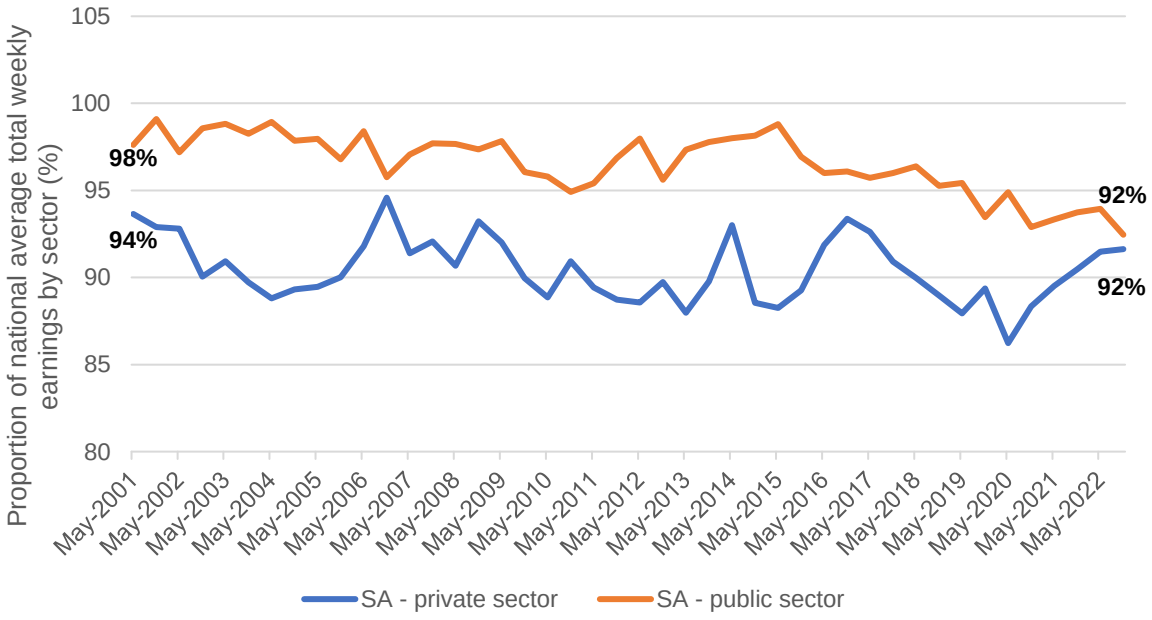
Figure 1: Annual GSP growth SA, and decadal averages SA and Australia, % per year



Note: 2020-21 and 2021-22 growth is not included in the 2010s decadal average as they are the first two data point of the 2020s decade
Source: Australian Bureau of Statistics (2021), 'Australian National Accounts: State Accounts'

This prolonged period of weak economic growth impacts on people's daily lives. Wages, both public and private sector, have also declined relative to the national average, with both private and public sector wages 8 per cent below the national average.

Figure 2: Average weekly total earnings, public and private sector, South Australia as a share of the Australian average



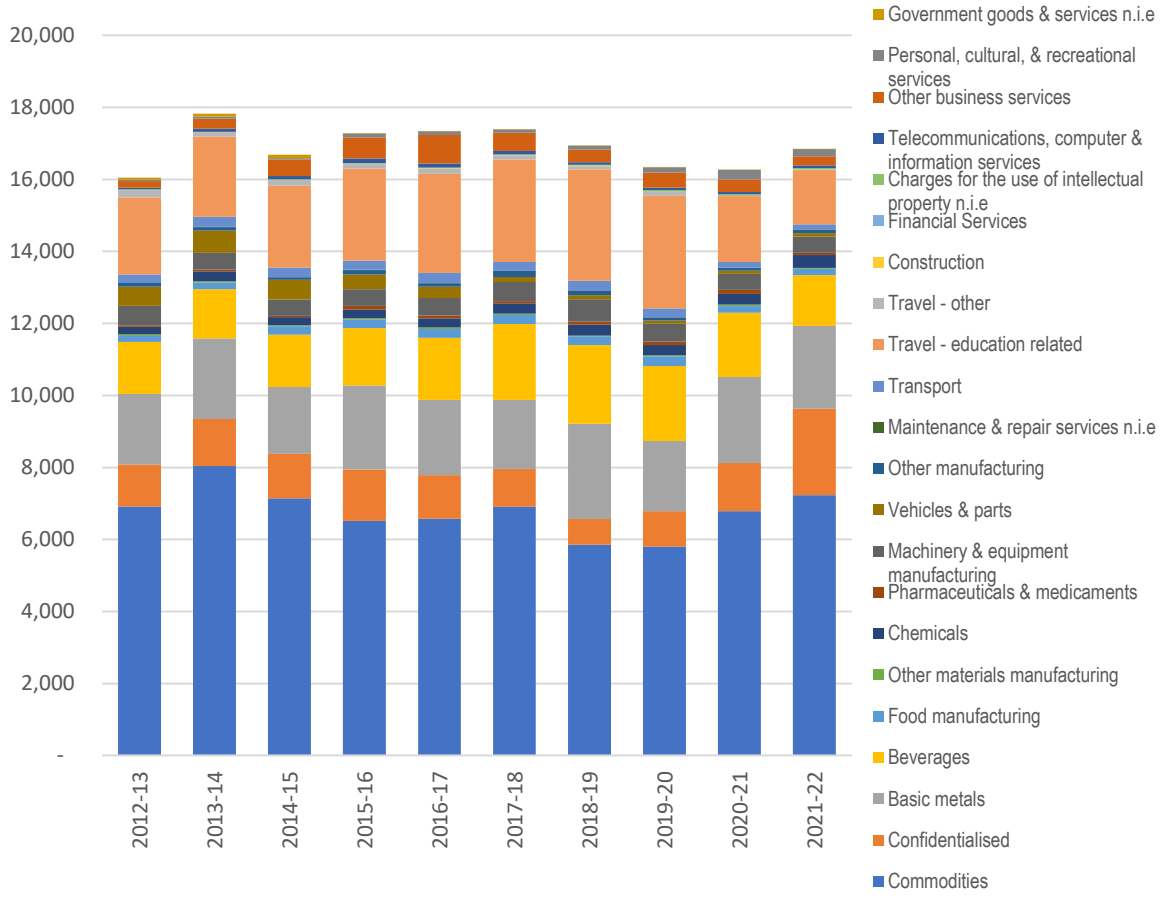
Source: Australian Bureau of Statistics (2022), Average Weekly Earnings, Australia

As well as being low growth, the South Australian economy shows little evidence of being high complexity. Exports are almost all in commodities and basic metals, while higher value-added exports are low and falling in real terms.

Exports data provides another perspective on the South Australia business sector. Exports can be a useful guide as to relative strengths as they will only occur when the local product has an advantage (whether price, quality, timing or marketing) over its international competitors.

Figure 3 presents export data over the past decade in real terms to reflect the impact exports had on the disposable incomes of South Australians but removing the impact of inflation. This demonstrates the extent to which the state's trade is dominated by the 'primary' sectors exporting agricultural goods, ores and hydrocarbons, and basic metals.

Figure 3: South Australian goods and services exports by broad SITC category, real 2022 $'million



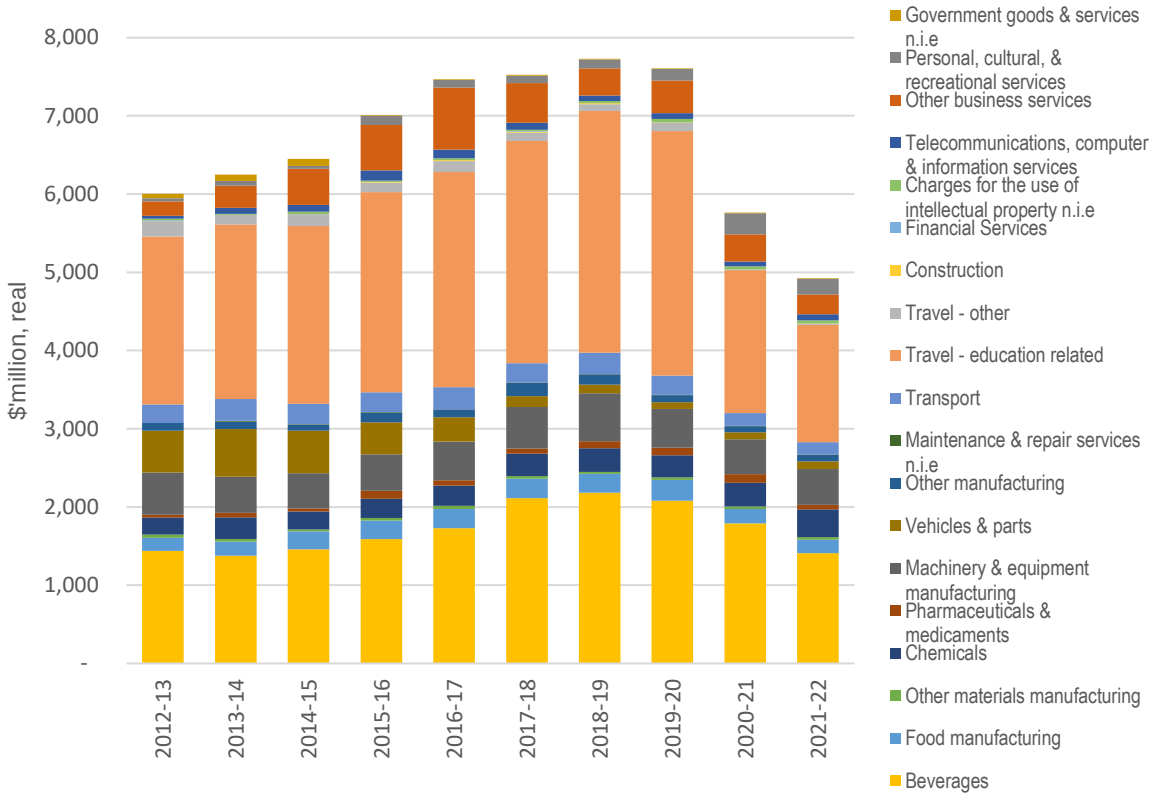
*Source: Goods data based on DFAT State & Territory pivot table (*https://www.dfat.gov.au/trade/trade-and-investment-data-information-and-publications/trade-statistics/trade-statistical-pivot-tables*), services data from Australian Bureau of Statistics (2022), 'International Trade: Supplementary Information, Financial Year, 2021-22'*

If these 'primary' goods are removed, it becomes apparent that the high value added goods and services exports from South Australia have actually fallen by over $1 billion in real terms over the decade (Figure 4), and by $2.8 billion from their peak in 2018-19. This is despite many of these subsectors having been a significant focus of SA Government innovation and trade policy supports over the past several decades.

The biggest falls since 2012-13 have been in 'Travel - education related' (-$644 million), 'Vehicles and parts' (-$434 million), 'Travel – other' (-$181 million), and 'Machinery and equipment manufacturing' (-$85 million).

Only three 'value added' export categories grew by more than $50 million over the decade; 'Personal, cultural, and recreational services' (+$156 million), 'Chemicals' (+$140 million), and 'Other business services' (+$71 million).

Figure 4: South Australian value-added goods and services exports by broad SITC category, real 2022 $'million



Note: chart excludes Agricultural goods, minerals and ores, confidentialised (which is largely barley and copper) and basic metals.
Source: Goods data based on DFAT State & Territory pivot table (2022), services data from Australian Bureau of Statistics (2022), 'International Trade: Supplementary Information, Financial Year, 2021-22'

Finding 2: The notable decline in the real value of high value-add exports from South Australia suggests that businesses in these sectors are becoming less internationally competitive.

1.2 Productivity is the key to sustainable growth

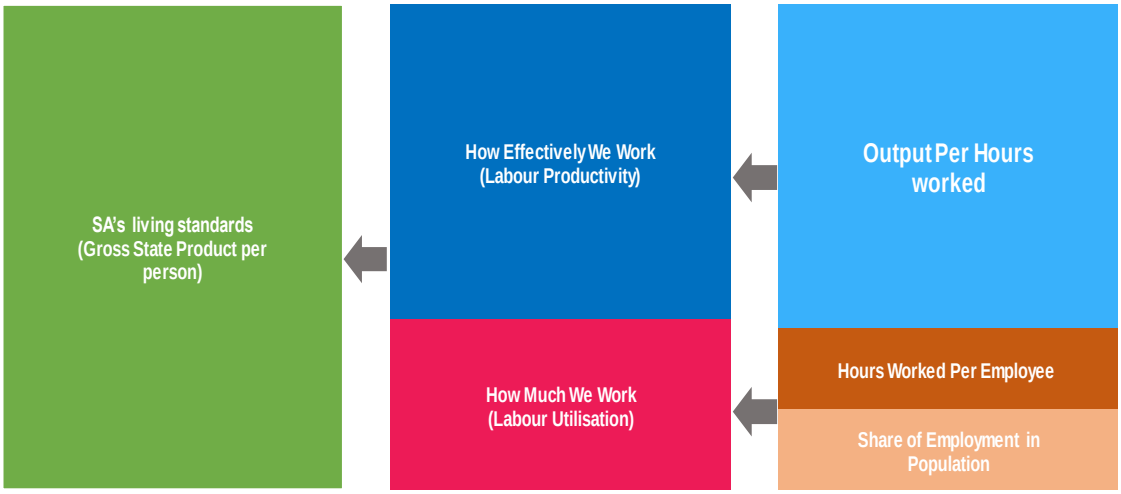
Standard of living is a key determinant of the quality of life in South Australia. South Australia's standard of living depends on two factors (Figure 5):

i. ***labour productivity***, i.e., the value of what the South Australian economy produces per hour worked – *how effectively we work*; and

ii. ***labour utilization***, i.e., the average number of hours worked per person in the population in the South Australian economy – *how much we work*.[7]

[7] Incomes can still rise if the South Australian economy's terms of trade improved, that is, the prices that we receive for goods and services that we export compared those that we import. It is important that resources are shifted to parts of the income where opportunities created by changes in the terms of trade can be captured (Productivity Commission (2013)).

Figure 5: Drivers of South Australia's living standards



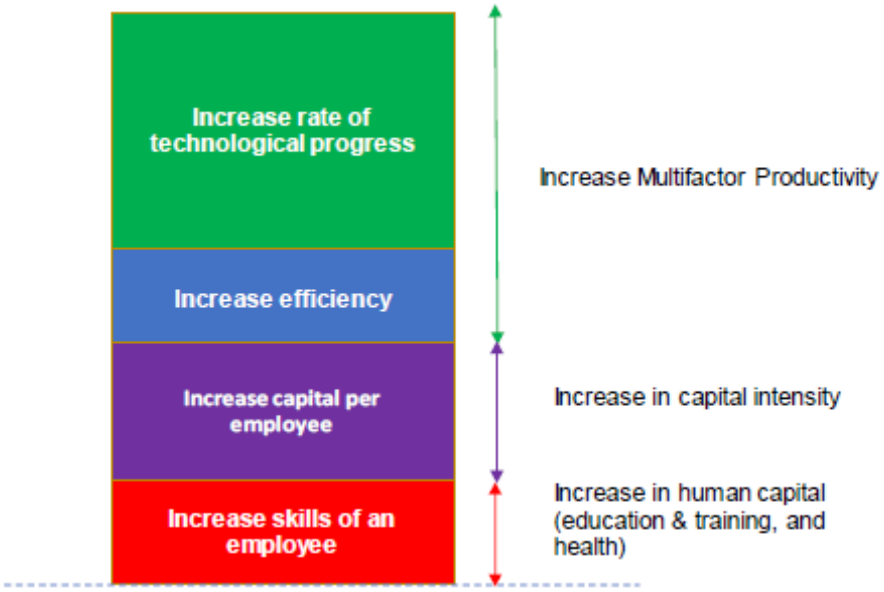
Source: Chang, Findlay and Whetton (2023)

Labour productivity is the only component that drives increases in South Australia's standard of living in the long run because there is an upper limit on the number of hours that workers want to work, and on the share of the population in paid work.

Increasing labour productivity also increases the competitiveness of local business, allowing them to grow, to hire more labour and to pay higher wages.

Higher labour productivity can be achieved through technological progress and efficiency improvements. This component is usually referred to as multi-factor productivity. It sits on top of contributions associated with the employment of e.g., more skilled labour or more capital to operate alongside the workforce. The various contributors to labour productivity are summarised in Figure 6.

Figure 6: Four drivers of labour productivity growth



Source: Chang, Findlay and Whetton (2023)

The South Australian economy cannot maintain its labour productivity growth by simply accumulating more skills or physical capital because both suffer from the law of diminishing returns. Opportunities for efficiency improvements can also eventually be exhausted, as the economy

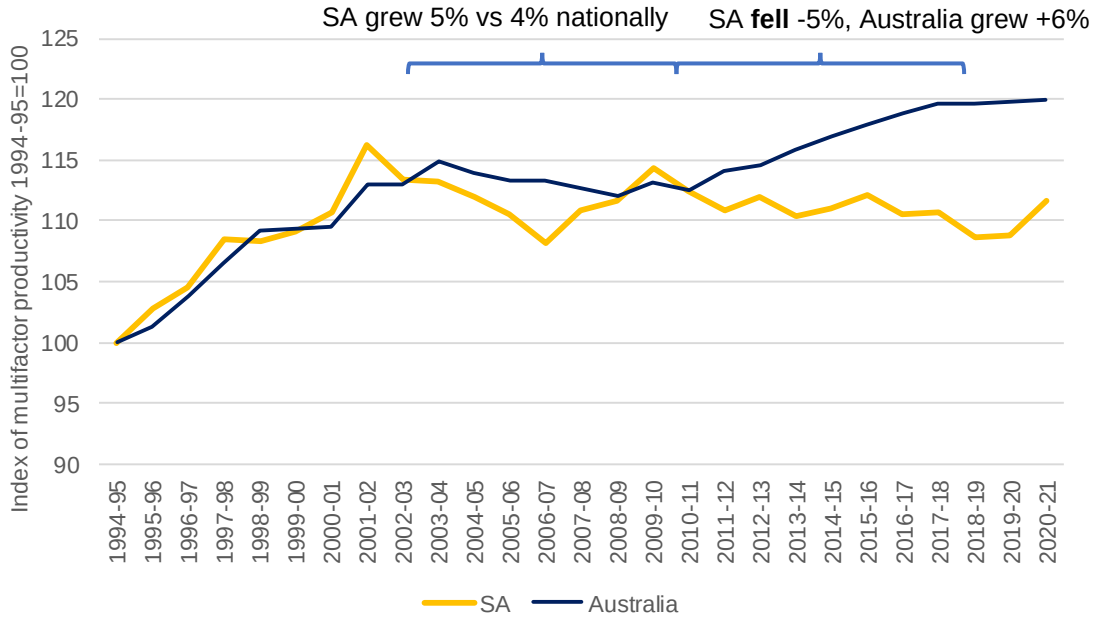
reaches its most efficient allocation. Productivity growth from technological progress will therefore be the main driver of long-term growth of labour productivity.

1.3 Poor productivity performance in South Australia

Unfortunately, South Australian multi-factor productivity growth has been weak, particularly over the last decade, see Figure 7. This weak productivity performance has been the main factor behind South Australia's growth in economic output falling well behind the national average in the 2010s.

Poor multifactor productivity performance is by no means inevitable – very solid growth was achieved through the 1990s – and it likely reflects a range of structural barriers that are holding South Australia back.

Figure 7: Multifactor productivity, South Australia and Australia, 1994-95 = 100



Australian Bureau of Statistics (2022, 2021) National Accounts (ABS Cat. No. 5204, Table 1 and, for the States and Territories, ABS Cat.No.5220.0, Tables 2-10)

Finding 3: South Australia's productivity growth has been poor over the past decade, and this is an important factor in the weak economic growth over the same period.

To delve into the causes of the decline in MFP growth, we need to examine the performance of the key factors influencing MFP, i.e., technological progress and efficiency change. This question is a topic of international research but less so in Australia.

The US experience shows that **technological progress contributed around half of output growth** in the US economy in the past 70 years. In fact, technological progress contributed around three-quarters and efficiency improvements contributed to around one-quarter to multifactor productivity growth during this period.[8] Figure 8 shows that increases in multi-factor productivity accounted for an average of 1.3 percentage points of the overall 2 percentage points growth in economic output (GDP). And technological change was the most important driver of productivity, accounting for half of the total growth or one percentage point.

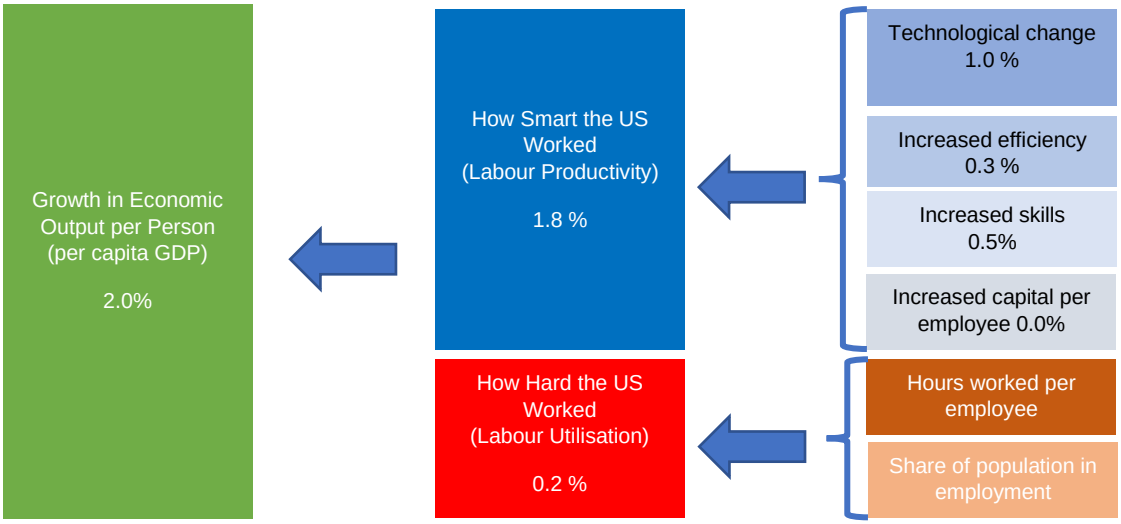
More broadly, across the OECD (not including Australia) it is estimated that technological progress increased at an average rate of 1.5 percent over a 15-year period (1990 – 2004), while efficiency

[8] Jones, C.I. (2022), 'The Past and Future of Economic Growth: A semi-endogenous perspective', *Annual Review of Economics*, 14:125–52

declined at an average rate of 0.6 per cent. The net effect resulted in MPF growth of 0.9 per cent over this period.[9]

One recent Australian study (Fox (2022)) finds that for South Australia, technological progress had stalled from early this century, and inefficiency had plagued the economy for almost the last two decades. The interpretation is that SA performance has declined because the state has fallen further behind in technological terms. Its failure to apply effectively even the technology already available has slowed its growth.

Figure 8: Components of long-run US growth of GDP per capita



Source: Jones (2022), Op Cit

The US experience shows what the impact of technological progress could have been for South Australia if our local economy had been able to keep pace with the global growth in technology

The US experience illustrates the impact of South Australia's failure to keep pace with technological change and knowledge improvement. If, over the last two decades, South Australia's innovation system had kept pace with the average global growth of technology and knowledge and delivered MFP growth of 1 percentage point per year (rather than the actual performance of no growth in MFP) GSP per person could have grown 1 percentage point faster per year over the last two decades (2000-01 to 2019-20).

If this had happened, South Australia's GSP per person would be comparable to that of New South Wales' GSP person in 2020, that is, about $13,500 higher than SA's actual GSP per person in 2020.

Wages broadly track economic output per person and productivity, so if South Australia *had* been able to reach New South Wales' productivity, then wages could also be expected to match those seen in New South Wales. For the average South Australian full-time worker this would mean earning $8,000 more per year.

Finding 4: If South Australia's rate of innovation had been at the long-run US average over the past two decades, our output per person would have been in line with New South Wales.

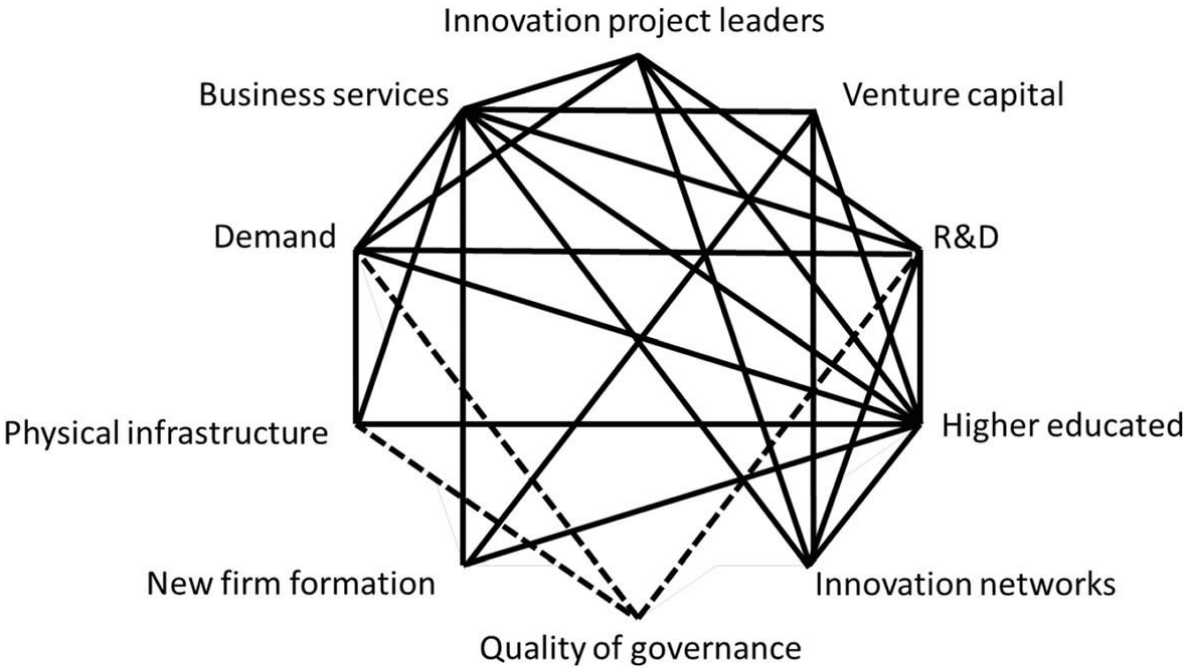
This identifies a significant problem in the operation of the innovation system in the state, that is, the mechanisms that develop and transfer technology (local, national and international) into application.

[9] Barcenilla-Visús, S., J.M. Gómez-Sancho, C. López-Pueyo, M.J. Mancebón and J. Sanaú (2013), 'Technical change, efficiency change and institutions: Empirical evidence for a sample of OECD countries', *Economic Record*, *89*(285), pp.207-227

R&D can occur in business, in universities, in government and in the not-for-profit sector.

Research and development can occur across the economy, although certain types of R&D are more likely in certain sectors. Business R&D and innovation, on average, tends towards the more applied side typically focussing on improvements in business processes, organisational management, marketing, and new or improved products. Much business innovation involves translating technologies invented elsewhere into the firm. Universities and government research institutions typically focus much more on 'basic' research with an emphasis on developing knowledge that is new to the world. The not-for-profit sector can undertake research across the spectrum from new to the world innovations through to translating international best practice into the local context but is more likely to be focussed on general knowledge rather than customer focused innovations. However, all these parties interact through an ecosystem which drives the process of innovation.

Figure 9: Elements of the innovation ecosystem



Source: Stam and Van de Ven (2021)[10]

There are many elements of the innovation system that are noted in Figure 9. Success means all the elements working effectively and interactively. The Commission's assessment is that a number of these elements are not the constraints on current performance. Indeed, the focus in this report is on only half of the items in this figure: the research institution elements (R&D but especially the education of the workforce) and the business elements of new firm formation operation, as well as the innovation networks which brings these elements together. Innovation leadership is also a focal point.

1.4 Innovation and the firm

Firms generally engage in two types of innovation: incremental; and transformative. They undertake incremental innovation to improve existing product lines, processes, or business models. They undertake transformative innovation to create new products, processes, or business models to capture markets from other firms, or create new markets. [11]

[10] Stam, E. and A van de Ven (2021), 'Entrepreneurial ecosystem elements', *Small Business Economics*, 56: 809-832
[11] Bessant, J. and Tidd, J. (2021), Managing Innovation, Seventh Edition, Wiley; Akcigit, U. and Kerr, W., (2018), "Growth through Heterogeneous Innovations", Journal of Political Economy, 126 (4), pp. 1374-1443; and Kerr, R. W. (2015),

Studies have found that the types of innovation undertaken by firms affect their rate of growth, which in turn affect the rate of economic growth and the magnitude of employment creation.[12]

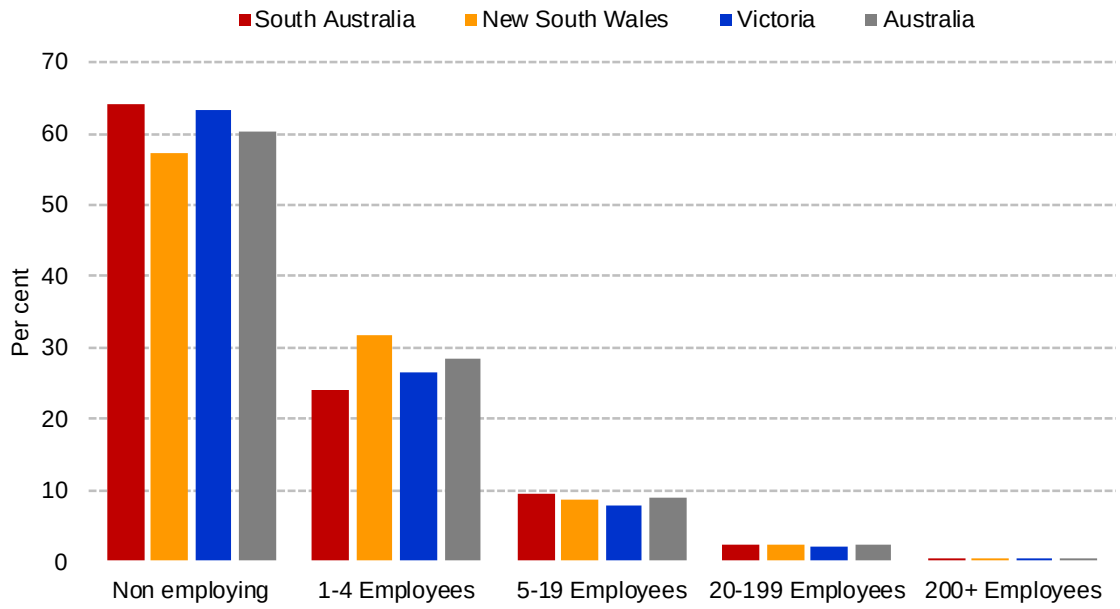
Most firms are small and targeted at specific market niches, innovation policy is unlikely to be of use to them.

For a majority of firms, transformative innovation is not relevant. They are sole traders or small firms with a clear market niche. Or they are firms addressing a specific emerging need, such as a new café setting up in a suburban area to cater to the higher rates of people working from home. Indeed, 64 per cent of South Australian businesses were non-employing businesses (e.g. sole traders) and a further 24 per cent employed one to four people (see Figure 10).

Nor is this small scale, or by and large, a temporary thing. Bakhtiari (2019), using BLADE data for the period 2002–2015, finds that:

- about 76 per cent of firms in Australia survive in the first three years, and about 39 per cent of firms survive during the first ten years;
- the majority of surviving firms hardly grow from age one to three;
- more than half of the surviving firms are still non-employers by age 3;
- less than 10 percent of firms from new to age 3 experience fast growth; and
- 'transformative' entrants make up a small share of the total.

Figure 10: Businesses by Employment Size, 30 June 2022, Proportion of total businesses



Source: ABS (2022), Counts of Australian Businesses, including Entries and Exits, accessed 20 February 2023.

This means that for most firms, innovation policy will not be relevant. Assistance is more likely to be needed around business skills, legislative compliance etc. The Commission notes that at the time of writing the South Australian Government is currently in the process of developing a small business

"Innovation and Business Growth." In Designing the Future: Economic, Societal and Political Dimensions of Innovation, edited by Austrian Council for Research and Training Development, 137–156. Vienna, Austria: Echomedia Buchverlag.

[12] Kerr, R. W. (2015), *Op Cit.*; Akcigit and Kerr *Op Cit.;* Henrickson, L., Taylor, D., Ang, L., Cao, K., Nguyen, T., and Soriano, F., (2018), The Impact of Persistent Innovation on Business Growth, Research Paper 2, Department of Industry, Innovation and Science, Canberra; and Majeed, O., Balaguer, A., Hansell, D., Hendrickson, L., Latcham, A., and Satherley, T., (2018), What Drives High Growth? Characteristics of Australian Firms, Research Paper 1, Department of Industry, Innovation and Science, Canberra.

strategy after an extensive consultation process. Such a strategy is likely to be a better approach to providing any support to the majority of small firms that are not innovation intensive.[13]

A small proportion of firms are 'high growth' firms and they account for a disproportionate share of net jobs growth and of innovation.

The potential drivers of transformative innovation are not new entrants, or small firms, in general, but rather those firms with the potential to become high growth firms.[14] High growth firms are not a large share of firms, recent research has found that 14 per cent of all firms in Australia were high growth firms in 2014, down from 18 per cent in 2005. But they have a disproportionate impact on the health of the economy accounting for 46 per cent of net jobs growth in Australia over the period. Compared to the average firm high growth firms are typically younger; more likely to engage in innovation; and pay higher wages.[15]

Finding 5: Most net jobs growth, and most job creating innovation in Australia occurs in high growth firms.

This means that enabling high growth firms, and firms that have the potential to be high growth firms needs to be at the centre of any policy focused on using business innovation to increase economic competitiveness and growth.

Finding 6: Policy aimed at stimulating economic growth through encouraging business innovation should be targeted at enabling high-growth firm (including firms with the potential to become high-growth).

Most high growth firms did not remain in the high growth phase for a long period of time with more than half of the high growth firms in the study period exiting their high-growth phase within 4 years, and only 11 to 14 per cent of high growth firms remaining in their high-growth phase after 7 years. However even after their high growth phase has ended, firms that have been high growth firms continue to have higher growth rates than the average.

Table 2: Median annual turnover growth by firm age, high-growth firms and all firms

	Turnover growth (per cent)	
Firm age	**High Growth firms**	**All firms**
4 years	55.2	6.6
5 years	12.5	2.9
6 years	6.1	–2.2
7 years	2.1	0.0
8 years	1.5	–3.0
9 years	1.1	–1.6
10 years	0.9	–1.6
11 years	2.3	–1.9

Source: Majeed et al. (2021)

[13] https://business.sa.gov.au/news/shaping-the-small-business-strategy
[14] Defined as firms with average annualised growth rates in turnover and/or employment of more than 20 per cent, sustained for at least a three-year period, OECD/Eurostat (2018), Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg
[15] Majeed, O., Balaguer, A., Hansell, D., Hendrickson, L., Latcham, A., and Satherley, T., (2021), What Drives High Growth? Characteristics of Australian Firms, Economic Record, 97 (318), p.350-364; Majeed, O., Balaguer, A., Hansell, D., Hendrickson, L., Latcham, A., and Satherley, T., (2018), What Drives High Growth? Characteristics of Australian Firms, Research Paper 1, Department of Industry, Innovation and Science, Canberra.

This pattern of growth is similar to international findings.[16]

1.5 This inquiry

The data set out in this chapter has painted a long-term picture of a state stuck in a low growth trajectory, falling behind the eastern states in economic output and in wages.

As well as being low growth, the South Australian economy shows little evidence of being internationally competitive outside of commodities. Exports are almost all in commodities and basic metals. High value-added, complex, goods and services exports have actually **fallen** by over $1 billion in real terms over the decade.

Productivity is the most important long-run driver of economic growth, but South Australia's productivity performance has been weak. The data shows that South Australia has fallen further behind the global 'technology frontier'. It is this failure to effectively apply the technology already available that has led to the significant slowdown in growth over the last decade. The available evidence suggests that this is because of consistently low levels of innovation and dynamism in South Australian businesses.

We know from international experience that a strong culture of research and innovation in business, and deep connections between regional research institutions such as universities[17] and the local business sector is critical to keeping pace with the global frontier of technology.

This inquiry is focused on that latter driver of business innovation. It aims to support the South Australian Government by undertaking a thorough examination of ***how research is turned into increased competitiveness*** for our state, including:

- the importance of research and knowledge diffusion for economic competitiveness;
- the effectiveness of current links between research institutions (including universities) and business, and of government programs supporting research and innovation; and
- what the State Government can do (including in collaboration with others) to help bridge the gap between the generation of knowledge and those who could put it to use.

The right policy settings right in this area it can make a significant contribution to addressing the productivity growth and income gaps with the rest of Australia, to increase the complexity and diversity of the state's economy, and to reduce the risks of excess dependence on our agricultural and mining sectors for our international competitiveness.

The goal is to significantly increase the number of South Australians who are employed in high-wage jobs, and in jobs which are more secure because they are innovating with the global economy rather than at the mercy of international economic trends.

Chapter 2 examines the potential drivers of innovation in South Australia, including the state's business community, exiting innovation policies, the state's universities, and its innovation workforce. It also outlines the international evidence on how to optimise university-business links around innovation.

[16] Moreno, F., and A. Coad (2015), 'High-growth firms: Stylized facts and conflicting results', *Advances in Entrepreneurship, Firm Emergence and Growth*, 17, 187-230; Brown, R., S. Mawson and C. Mason (2017), 'Myth-busting and entrepreneurship policy: the case of high growth firms', *Entrepreneurship & Regional Development*, 29 (5-6), 414-443; Satterthwaite, S. and R. Hamilton (2017), 'High-growth firms in New Zealand: Superstars or shooting stars?', *International Small Business Journal*, 35(3), pp. 244-261; Coad, A., J.R. Holm, J. Krafft and F. Quatraro (2018), 'Firm age and performance', *Journal of Evolutionary Economics*, 28 (1), pp. 1-11.

[17] In addition to its research universities, South Australia also has a number of substantial public research institutions such as SAHMRI. In most cases through the report the use of the word universities should be taken to also encompass the public research institutes.

Chapter 3 then outlines our initial conclusions of the set of policy interventions that appear to be best placed to improving the link between the state's research institutions, and researchers, and business to foster a culture of world-class business innovation in the state.

2. Potential Drivers of South Australian Innovation

2.1 South Australia's business sector

South Australian businesses are generally very small…

As noted previously, South Australian businesses are typically very small, with non-employing and micro businesses predominating.

And are less dynamic that those in other states

Business entry and exit rates provide insight into the levels of entrepreneurship, business dynamism and competition within an economy (Bakhtiari, 2019; Shambaugh et al., 2018). For example, a high rate of business entry may suggest strong entrepreneurship and a conducive environment to starting new businesses, which can lead to job creation and innovation. High business exit rates can indicate that the market is competitive with less-competitive businesses exiting to make room for new and more innovative and efficient businesses.

South Australia had lower overall business entry and exit rates than New South Wales, Victoria and Australia in 2021-22 (see Table 3). The lower entry and exit rates were particularly prominent among non-employing and micro businesses. The difference between entry and exit rates across all businesses was also smaller in South Australia (5.5 per cent) than in Australia (7.0 percent), indicating a lower level of net business formation. Together these results are suggestive of a lack of entrepreneurial dynamism within South Australia.

Table 3: Business entry and exit rates by employment size, 2021-2022, entries and exits as proportion of businesses at the start of the year

	Non employing	1-4 Employees	5-19 Employees	20-199 Employees	200+ Employees	Total
	Business entry rates					
South Australia	20.4	13.7	4.1	2.6	4.0	16.8
New South Wales	23.7	14.8	4.0	2.2	2.8	18.5
Victoria	31.6	14.9	4.2	3.2	3.5	23.8
Australia	25.1	15.2	4.1	2.7	3.0	19.7
	Business exit rates					
South Australia	14.2	7.6	4.4	2.8	1.3	11.3
New South Wales	16.9	9.1	4.7	3.4	2.4	12.9
Victoria	16.1	8.7	5.0	3.0	4.6	12.7
Australia	16.2	8.9	4.9	3.2	2.4	12.7

Source: ABS (2022), Counts of Australian Businesses, including Entries and Exits, accessed 20 February 2023

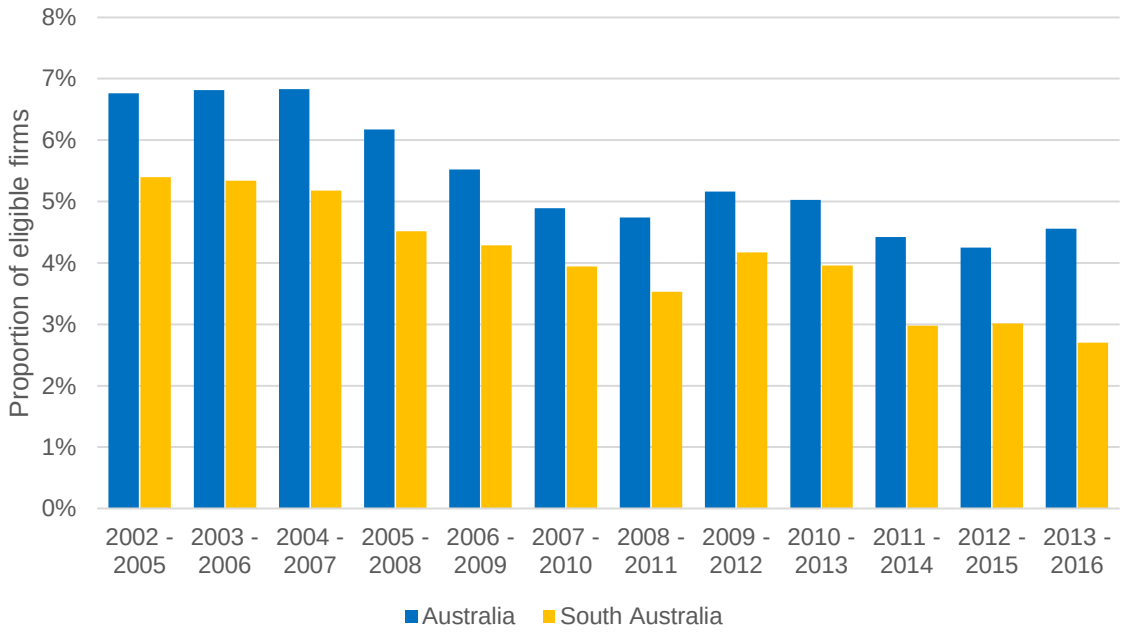
Finding 7: South Australia's business is much less dynamic than the national average (with both lower entry and exit rates). This, and smaller average size of businesses, reduces business innovation and so it is likely that there is less scope for business innovation amongst the current SA business community than the eastern States

South Australian firms are much less likely to be high-growth, and this is true across industry sectors

Analysis of the BLADE dataset by DIIS (unfortunately now somewhat dated, but still we believe relevant) shows that South Australian firms are significantly less likely to be high-growth firms than the national average, and that this underperformance was consistent from 2002 to 2016 (Figure 11).

As was the case for Australia as a whole, the proportion of high growth firms has been declining, with the rate of decline being slightly higher than the national average. By 2013-16, around 2.7 per cent of South Australian firms were high growth compared to a national average of 5.5 per cent.

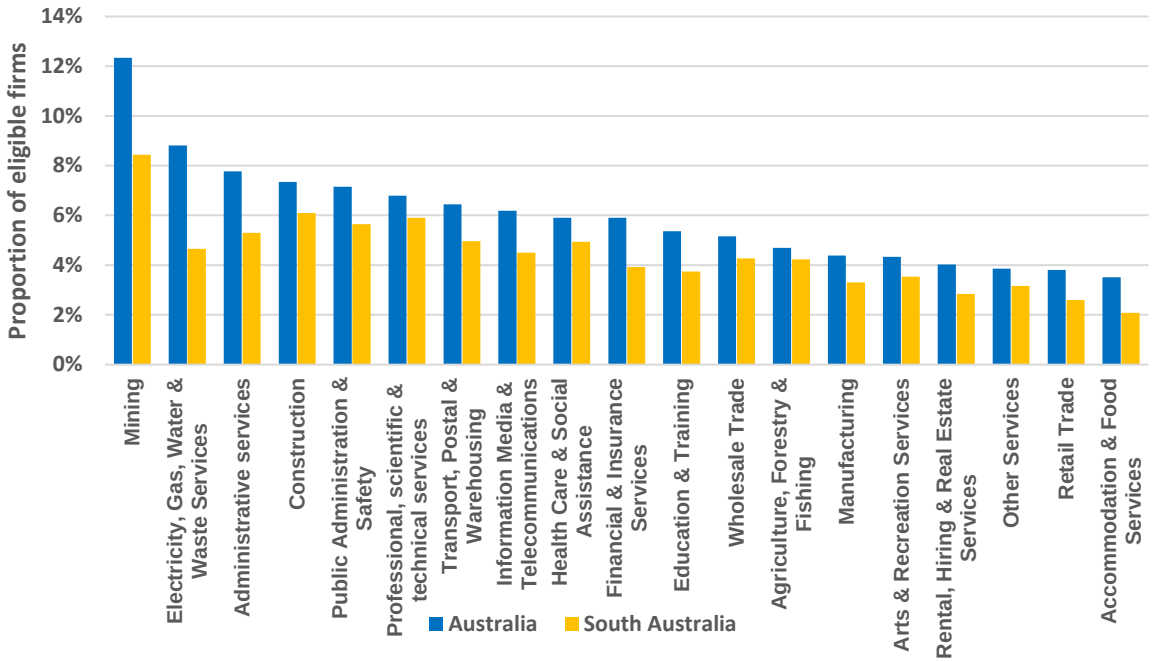
Figure 11: Proportion of firms which are 'high-growth' by year, Australia and South Australia



Source: B Dobson-Keeffe, SA Department for Innovation and Skills, unpublished data

Finding 8: South Australian businesses are less than half as likely to be 'high growth firms' than the national average.

Figure 12: Proportion of firms which are 'high-growth' by industry, sorted in descending order of Australian share, Australia and South Australia



Source: B Dobson-Keeffe, SA Department for Innovation and Skills, unpublished data

This underperformance relative to the national average doesn't (at least primarily) reflect differences in industry structure, with South Australian firms being less likely to be high growth in each of the 19 included industry sectors (see Figure 12).

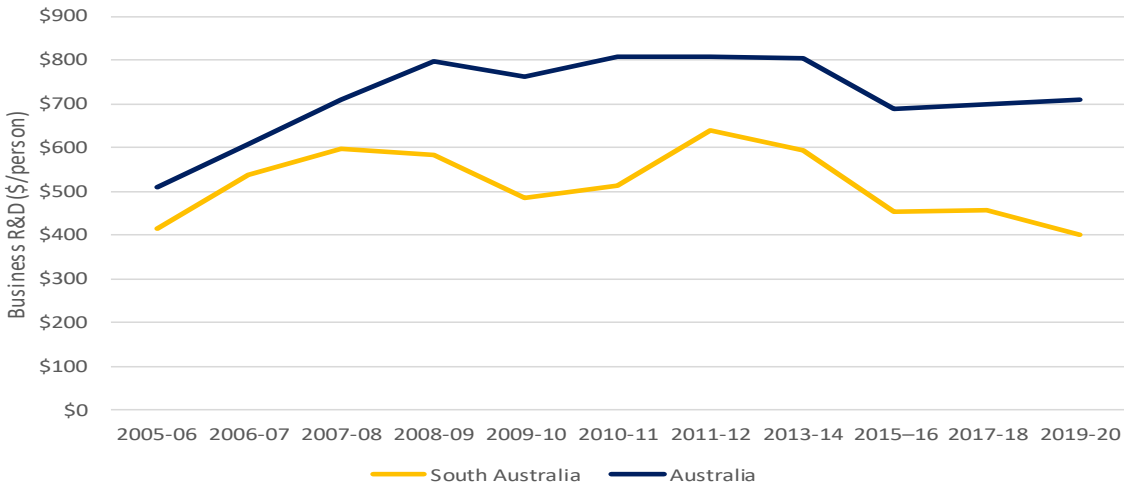
The relative underperformance in high growth firm share was greatest in 'Electricity, gas, water and waste services' where less than half as many South Australian firms were high growth compared to the national average. 'Mining', 'Administrative and support services', and 'Financial services' also had significant under performance relative to the national average.

Finding 9: South Australia's low rate of high-growth firms is not primarily a result of the state's industry structure, but is evident in every industry sector.

South Australian firms invest much less in R&D than those interstate

Figure 13 shows that business spending on R&D per person has fallen slightly in South Australia over the last 15 years, whereas national average spending is higher although below its level in the early 2010s.

Figure 13: Expenditure by business on Research and Development, $ per person (2021 values)



Source: ABS 81040 Research and Experimental Development, Businesses.

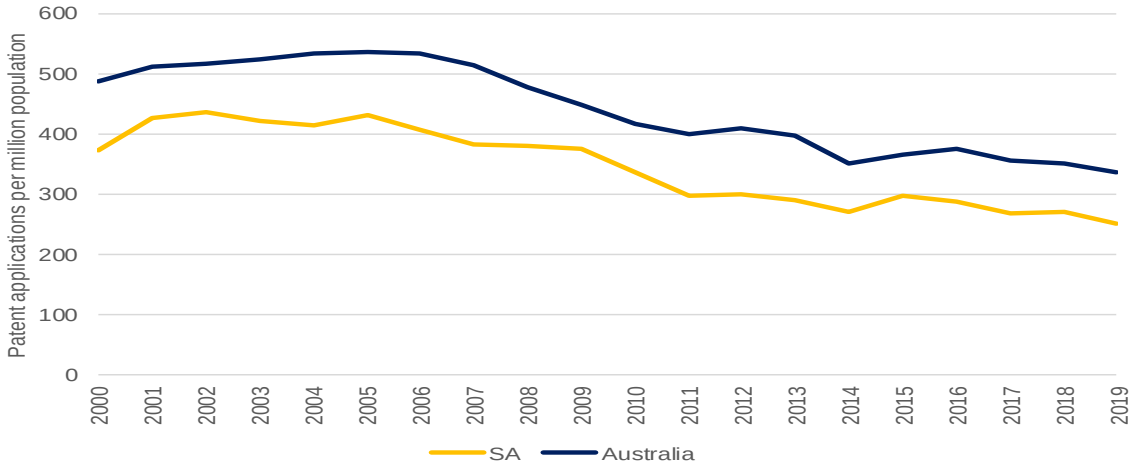
Analysis undertaken for the Commission by the ABS as part of the 2021 Inquiry into Research and Development, suggested that the underperformance on R&D is heavily influenced by the relatively older average firm age, and the smaller average size of South Australian businesses.

Finding 10: South Australian firms invest less than the national average in R&D and this gap has been widening.

South Australian firms are less likely to patent

Patents are often used to measure the success of R&D efforts. They are designed to incentivise innovation. However, in practice, not all patents have led to innovations because it is dependent on other factors, such as access to financial capital, practical application, regulations, potential markets, etc. Nonetheless, a larger pool of patents would increase the likelihood that a patent could lead to an innovation. Conversely rates of patenting vary between sectors reflecting different approaches to the protection of IP. Patent applications in South Australia have been consistently lower than the national average, suggesting innovation output in the state is below average (Figure 14).

Figure 14: Patent applications per million persons, SA and Australia



Source: IP Australia.
Note: Data for 2020 and 2021 not included as there is a structural break in the series.

… and tend to be more 'inward looking' in their innovation, with a particularly low likelihood to draw on universities as a source of ideas.

Data on the innovation activities of South Australian firms collected by the ABS as part of their business surveys[18] paints an interesting picture of the local innovation ecosystem. The overall propensity to undertake any form of innovation in SA firms is similar to that in other states, of the order of 50 percent. Like other states, that effort is dominated by attention to process innovation, rather than creation of new products or services. Innovation is mainly targeted on the local market.

Skills identified as required for innovation are mainly those related to management rather than technology. Hardly any of the innovation is transformative (most only new to the firm, and not even the local industry).

Key sources of ideas are internal including customers: the contribution of competitors scores higher than that of external research providers.

However, SA firms are also outliers in several respects. They

- make relatively small use of government support
- are less likely to seek additional funds for innovation
- use a narrower source of funds for innovation
- look more likely to focus on one project at a time and have less activity in the innovation pipeline
- put more weight on lack of access to skills and on 'uncertain demand' as barriers to innovation
- make far less use of universities as a source of ideas – only 3 per cent of innovating firms in SA identify universities as a source of ideas for innovation;
- tend to collaborate with their own businesses, with competitors or businesses from the same industry, and they make less use of consultants
- undertake far less joint R&D with collaborators and focus more on sharing facilities or undertaking joint marketing.

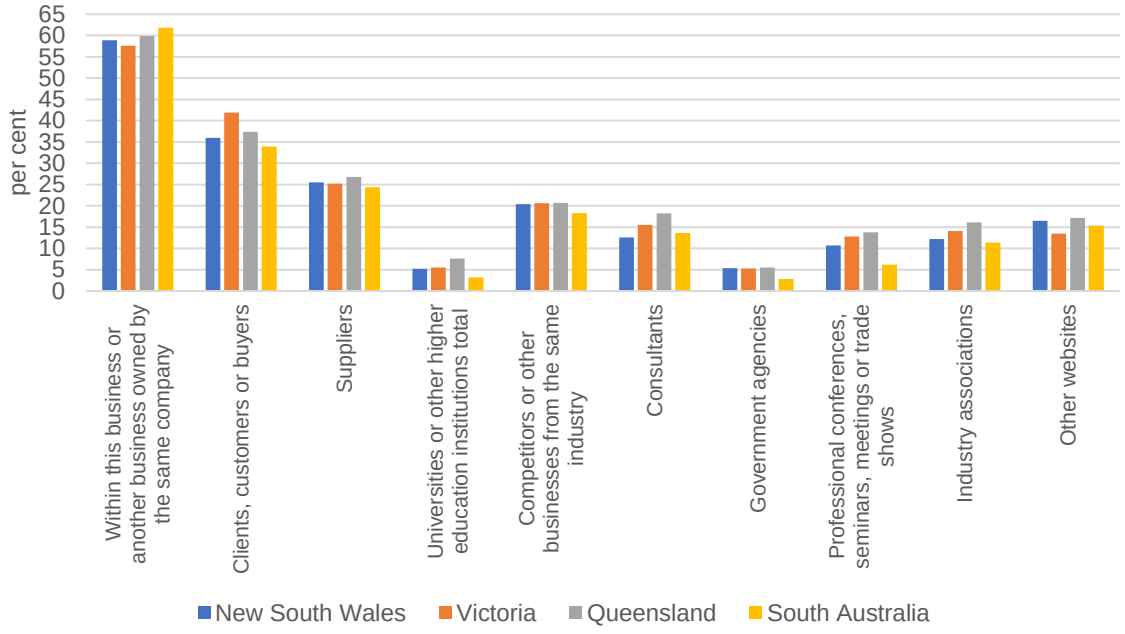
Given the focus on process innovation and not new goods and services, and given the lack of novelty involved, then it's not surprising that Australian firms make little use of research

[18] Australian Bureau of Statistics (ABS) (2022) 'Characteristics of Australian Business, 2020-21'

organisations. This is evident in Figure 15. **Only 3 per cent of South Australian innovation active firms identified universities as a source of ideas for innovation.**

South Australian firms source ideas from inward oriented sources – within the business group or from clients or suppliers. External sources are relatively less important, including consultants, government agencies, industry associations etc.

Figure 15: Sources of ideas for innovation, innovation active firms, per cent of total



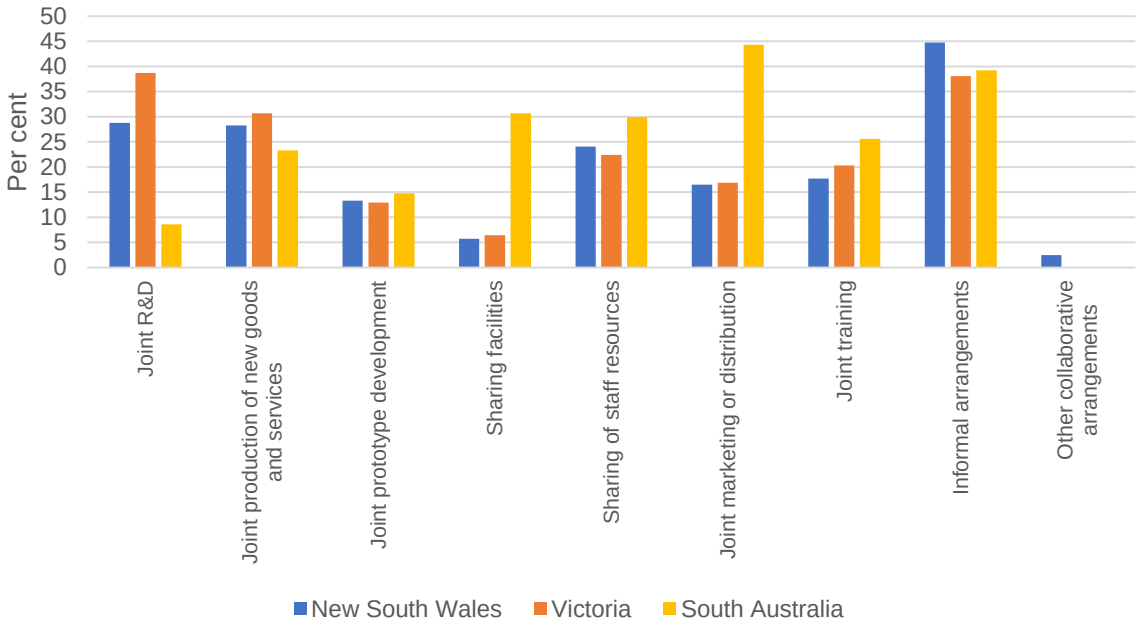
Source: ABS (2022), Characteristics of Australian Business, 2020-21

Finding 11: South Australian businesses are very inward looking in terms of sourcing ideas for innovation, with only 3 per cent of South Australian innovation active firms identifying universities as a source of ideas, and only 1 per cent collaborating with a university on innovation.

Universities score (extraordinarily) low for all states, but especially SA. Even more concerning when Universities *are* used, passive engagement such as access to journals and publications, and academic conferences are reported to be more important than other, more direct, engagement with the university such as joint research, which is reported by only one per cent of innovation active South Australian firms.

SA is also an outlier with respect to the types of collaborative arrangements, see Figure 16. SA firms are much more likely to be involved in sharing facilities or in joint market arrangements. They are much less likely, by a factor of 6 to 7, to be involved in joint R&D.

Figure 16: Types of collaborative arrangements around innovation, innovation active firms, per cent of total



Source: ABS (2022), Characteristics of Australian Business, 2020-21

2.2 South Australian innovation policy

The lead South Australian Government agency on innovation policy is the Department for Innovation, Industry and Science (DIIS). It is responsible for managing the delivery of the EXCITE strategy (focused on research) and the FIXE strategy (focused on entrepreneurialism). The Chief Scientist of SA and the SA Chief Entrepreneur are both located within DIIS and form part of its policy development system.

Other innovation support policies are located within Primary Industries and Resources SA, the Department for Trade and Industry, and the Department for Energy and Mining.

The supports currently offered by the SA Government can be broadly characterised as having significant breadth, but as a consequence many of the individual interventions (and indeed individual objectives) have relatively limited resources allocated to them. This also makes the innovation support system harder to navigate for businesses or researchers seeking to access support.

In order to better understand the relative effort going into different aspects of research and innovation policy, the Commission has mapped the programs supported by the SA Government aimed at supporting business innovation against the framework developed by the OECD in their review of university-industry collaboration, see Figure 17.[19]

Amongst the range of programs implemented, a small number of types of support were very common:

- Financial support for universities to host industry researchers;
- Funding of infrastructure and intermediaries for collaboration
- Networking support to build industry/research linkages

[19] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66, pp. 48-50

- Outreach activities to raise awareness of research sector/ industry opportunities; and Subsidies/grants for industry R&D and innovation

Finding 12: South Australian has a large number of innovation programs, but most are small and have limited funding.

Information request: Resourcing of programs

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether the current model of offering a wide range of programs around research and innovation, and as a consequence reducing the average level of resources per program suits the state's needs. Or would it be better to move to a model of significantly fewer programs, but each with more substantial resourcing.

The overall level of funding appears to be reasonably substantial, although the plethora of funding streams and the extent to which they nest within one another creates the potential for double counting. Initial calculations suggest that across the programs operated by DIIS, DTI and PIRSA to support business innovation (including the operating grant for SAHMRI and SARDI and the HMRF funding allocated to SAHMRI, but excluding spending on Lot 14) there is of the order of $35 million currently being allocated to innovation programs.

Figure 17: Mapping of SA Government programs on innovation to the OECD framework

Program or program element	Subsidies/grants for industry R&D and innovation	Vouchers/grants for firms to purchase R&D services from universities	Tax incentives for firms purchasing research from universities	Financial support to firms to recruit PhDs and post-docs	Performance based funding systems for university linkages with industry	Public private partnerships creating joint research laboratories	Financial support for universities to host industry researchers	Funding of infrastructure and intermediaries for collaboration	Grants for IP applications from universities	Financial support to academic spin-offs	Public procurement of university research	Reform of IP regulations regarding publicly funded research	Reform of regulation relating to spin-offs from academics and students	Sabbaticals and mobility schemes to support researchers working in industry	Career rewards for researchers engaging in knowledge transfer to	Open access and open data provisions for publicly funded research	Collaborative industry/ research sector road-mapping and foresight exercises	Training programs on knowledge collaborations	Guidelines, standards and codes of conduct for industry/ research	Networking support to build industry/research linkages	Outreach activities to raise awareness of research sector/ industry
Wine Export Recovery and Expansion Program																					
Global Expansion Program																					
Brandon Biocatalyst								X	X	X										X	
Australian Institute of Machine Learning (AIML)	X	X				X	X							X						X	X
SA Cooperative Research Centre Program	X			X		X	X	X							X				X	X	X
AMREx - Flinders University and University of Strathclyde							X														
GigCity								X													
Go2Gov	X									X											
Industry Doctoral Training Centres						X	X								X			X		X	X
Innovation Challenge	X							X													
External Innovation and Translation Intermediary							X	X									X	X		X	
Manufacturing Growth Accelerator							X													X	

Program or program element	Subsidies/grants for industry R&D and innovation	Vouchers/grants for firms to purchase R&D services from universities	Tax incentives for firms purchasing research from universities	Financial support to firms to recruit PhDs and post-docs	Performance based funding systems for university linkages with industry	Public private partnerships creating joint research laboratories	Financial support for universities to host industry researchers	Funding of infrastructure and intermediaries for collaboration	Grants for IP applications from universities	Financial support to academic spin-offs	Public procurement of university research	Reform of IP regulations regarding publicly funded research	Reform of regulation relating to spin-offs from academics and students	Sabbaticals and mobility schemes to support researchers working in industry	Career rewards for researchers engaging in knowledge transfer to	Open access and open data provisions for publicly funded research	Collaborative industry/ research sector road-mapping and foresight exercises	Training programs on knowledge collaborations	Guidelines, standards and codes of conduct for industry/ research	Networking support to build industry/research linkages	Outreach activities to raise awareness of research sector/ industry
Medical Device Partnering Program							X													X	
The National Collaborative Research Infrastructure Strategy						X	X	X													
SA Venture Capital Fund										X											
Start-up Hub																		X		X	X
UniSA Future Industries Accelerator	X	X					X	X												X	X
University of Adelaide CNRS Research Exchange							X							X						X	
University of Adelaide Future Industry Making Fellows Program							X							X						X	
Lot Fourteen								X										X		X	X
South Australian Health and Medical Research Institute (SAHMRI)					X		X	X		X										X	X
South Australian Agricultural Research and Development Institute (SARDI)						X	X	X					X							X	X

2.3 South Australian research institutions

South Australia's universities

South Australia's three research universities – Flinders University, the University of Adelaide, and the University of South Australia – are the state's most significant research institutions. Between them they host 66,383 undergraduate students, 25,620 post-graduate students and employ 3,930 academic staff (see Table 4). South Australia also has a substantial private university, Torrens University, but as that is primarily focused on teaching it has not been included in this analysis.

The University of South Australia has the highest student numbers, but the University of Adelaide has substantially higher total revenue and research revenue than the other two institutions.

It is also clear from the data that the financial scale of South Australian universities is driven by student income. Research accounts for only 14 per cent to 25 per cent of the income of South Australian's universities.

Table 4: Key characteristics of South Australian Research Universities, as at 2021

	Flinders University	University of Adelaide	University of South Australia
Undergraduate students			
Domestic	14,219	16,327	26,234
International	1,349	4,801	3,453
Post-Graduate students			
Domestic	6,131	5,094	4,955
International	3,171	4,263	2,006
Academic staff			
Research and teaching (FTE)	412	734	491
Research only (FTE)	396	675	477
Teaching only (FTE)	242	168	335
Total academic (FTE)	**1,050**	**1,577**	**1,303**
Professional staff (FTE)	**1,167**	**1,927**	**1,535**
Research income ($'million)	**81.4**	**298.5**	**94.4**
Total revenue ($'million)	**552.4**	**1,146.6**	**677.3**

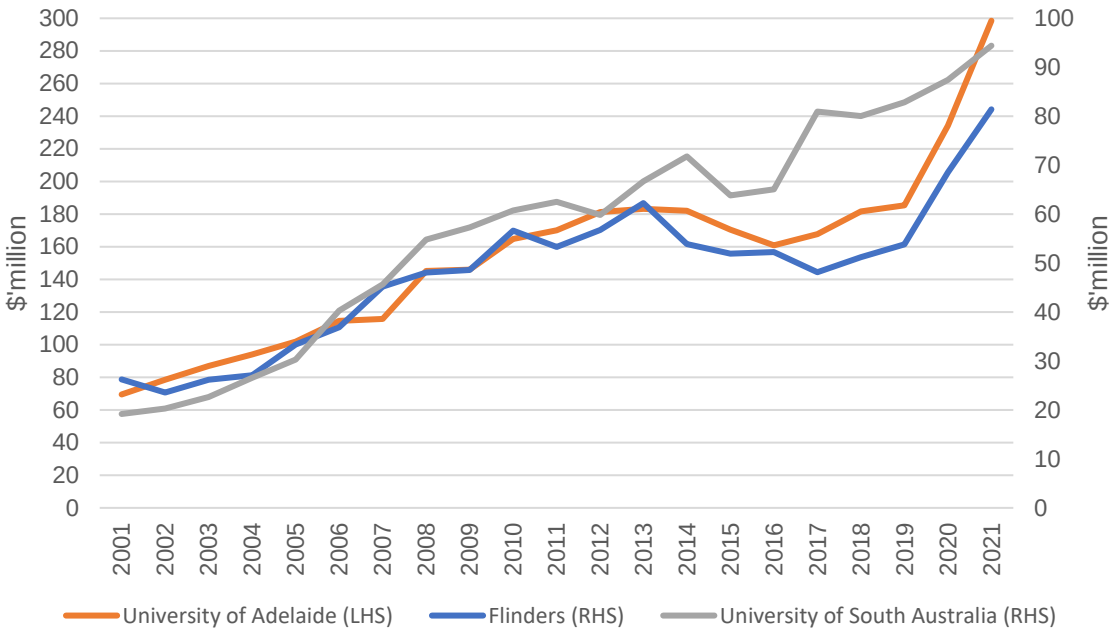
Source: Department of Education, Selected higher education statistics, Flinders University 2021 annual report, University of Adelaide 2021 annual report, University of South Australia annual report.

Finding 13: The revenue of South Australia's universities, and therefore the incentives that they face, is largely driven by student income.

Research performance

Total research income for each of the South Australian universities has grown strongly over the past decade. In the case of Flinders University and the University of Adelaide that has been largely through very strong growth since 2019, in the case of the University of South Australia the growth rate has been more consistent over the decade (Figure 18).

Figure 18: Total research income, South Australian research universities, $million nominal



Source: Australian Government Department of Education (2022), 'Higher Education Research and Development Income time series (1994-2021)'

Despite the strong overall growth in the value of research income comparisons with other states suggest some potential areas of concern/weakness:

- South Australia's share of national NHMRC funding continues to decline. From a high of almost 11 per cent of the national total in 1994, SA's share has dropped to 7.4 per cent in 2009 and 6.3 per cent in 2021.
- Similar, although less severe, trends can be observed in ARC research grant data, with SA having fallen from 6.4 per cent of national funding in 2017 to 5.5 per cent in 2021 (although growth in other forms of category 1 research has been strong over the same period, such that overall, the share of national category 1 funding has increased).
- Perhaps of greatest concern, analysis by the Office of Chief Scientist SA (OCSSA) has identified that grant schemes targeted at supporting the development of early career researchers have some of the smallest South Australian funding shares. For example South Australian researchers only received 3 per cent of NHMRC Investigator grants in 2021. This relative weakness in funding for early career researchers has the potential to restrict the pipeline of talented young researchers in South Australia, potentially worsening the funding gap still further.

Research strengths

There are a number of areas of significant research strength across South Australia's universities. Analysis of field weighted relative citation rates by OCSSA have identified the following disaggregated fields of research in which South Australian research output quality is collectively ranked towards the top of the OECD:

- Applied mathematics;
- Artificial intelligence;
- Astronomical and space sciences;

- Atomic, molecular and optical physics;
- Chemical engineering;
- Classical physics;
- Computer vision and multimedia computation;
- Condensed matter physics;
- Data management and data science;
- Electronics, sensors and digital hardware;
- Environmental biotechnology;
- Fluid mechanics and thermal engineering;
- Human-centred computing;
- Industrial biotechnology;
- Medical biotechnology;
- Macromolecular and materials chemistry;
- Materials engineering;
- Mechanical engineering;
- Nanotechnology;
- Nuclear and plasma physics;
- Particle and high energy physics; and
- Quantum physics.

Finding 14: South Australia has a number of areas of world class research strength. And a number of these research areas map well to key economic priorities for the state such as the green energy transition, and the defence sector.

Information request: Research strengths

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on the most reliable approaches to identifying areas of research strength in South Australia relative to our key international peers, and any available analysis on what those areas of relative strength may be.

University industry collaboration

As noted in chapter 1, South Australian businesses are very inward looking in terms of sourcing ideas for innovation, with only 3 per cent of South Australian innovation active firms reporting that they used universities as a source of ideas for innovation, and only 1 per cent reporting having collaborated with a university on innovation.

Bibliometric analysis undertaken by OCSSA suggests that the majority of South Australian STEMM fields are ranked in the bottom half of the OCED for research-business collaboration (based on the inclusion of industry co-authors on research publications). Australia is also ranked relatively low in the OECD for research-business collaborations in most STEMM fields and in global surveys of R&D performance such as the 2022 Global Innovation Index.

A major challenge identified by OCSSA in their analysis is improving technology diffusion into businesses in manner which allows them to compete with those who move quickly to adopt a new technology ahead of the market.

Another significant barrier for industry research engagement identified by OCSSA is the lack of awareness of existing research facilities by local businesses. For example, OCSSA

consultations on NCRIS facilities suggest that a large majority of businesses were not aware of their existence.

Industry funded research income for the three universities paints a somewhat more positive picture. In 2021 South Australian universities accounted for 6.8 per cent of the national income for Category 3 - Industry and other Funding for Research, only just below the state's population share (although given that Australia as a whole ranks poorly in the OECD for research-business collaborations, being in line with the national average is not indicative of an internationally competitive position).

Information request: Potential for research industry collaboration

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on the areas of current strength in research-industry collaboration, and approaches that could be used to identify areas with the potential for such strength to develop.

Other research institutions

In addition to the three universities South Australia also hosts several state based institutions, the largest of which are the South Australian Health and Medical Research Institute and SARDI, and local nodes of the two major national research institutions, The Defence Science and Technology Group and the CSIRO.

The **South Australian Health and Medical Research Institute** (SAHMRI), was established in 2009 as an independent Medical Research Institute, incorporated as a company limited by guarantee jointly owned by the SA Government and the three research universities. SAHMRI's founding objectives were to reverse the decline in the state's health and medical research performance and to enhance collaborations between existing researchers and research teams.

The **South Australian Research and Development Institute** (SARDI) is the state's single largest public research institution, delivering 'science outcomes for public good'. As the principal research arm of the Department of Primary Industries and Regions South Australia (PIRSA) SARDI undertakes applied research and development aimed at supporting South Australia's primary industries and food and wine sectors, including facilitating practice change on behalf of the SA Government.

The **Defence Science and Technology Group** (DSTG), is the Australian Government's lead agency responsible for applying science and technology to safeguard Australia's national interests. DSTG has a significant R&D presence in SA. Its largest Australian operation is located at Edinburgh in Adelaide, and is home to more than 1,200 scientists, engineers, IT specialists and support staff undertaking military research in areas such as: surveillance systems, autonomous systems, electronic warfare, information systems, propulsion and energy, weapons effects, human science and operations analysis[20]. It also has a policy for R&D collaboration with partners and industry through the Research Collaboration Security Framework.

The **CSIRO** is the Australian Government's primary scientific research agency with 5,672 people employed across 53 sites throughout Australia and globally. The scale of CSIRO's

[20] Defence SA, Defence Science and Technology, (Web Page, undated) <https://defencesa.com/projects/research-and-development/>

South Australian operations are smaller than DSTG's, with three of its total of 53 sites located in South Australia.

2.4 South Australia's research workforce

An economy's ability to innovate depends, in part, on the resource effort devoted to carrying out innovation-related activity. These resources primarily comprise spending on research and development (R&D) and human capital (Stern et al 2000). The ability of human capital to contribute to innovation depends not only on the number of people employed to carry out R&D activity, but also the quality of human capital in terms of the knowledge and skills held by workers. For example, an analysis of innovation activity across Australian industries found that the share of persons with a degree or post-graduate degree was around a third higher for high-innovation industries compared to medium- or low-innovation industries, notwithstanding some considerable variation within the high-innovation industries themselves (Toner, 2011).

In addition to obtaining high levels of formal education and training, having sufficient skills within specialised knowledge areas also contributes to innovation capacity. For example, the development of new goods, technologies and services generally requires skills in relation to science, engineering, technology and design (OECD, 2011). Attracting more people to study science, technology, engineering and mathematics (STEM) has become a central pillar of many OECD innovation strategies given the fundamental role these fields play in generating new knowledge (OECD, 2016).

Educational Attainment – PhDs and Masters

South Australian workers are just as likely to have a PhD as workers for Australia as a whole with 1.3 per cent of employed people in South Australia having a doctoral degree as their highest level of educational attainment.

There are some notable differences in the propensity for workers to have a doctoral degree between South Australia and Australia as a whole among certain industry sectors. In 2021, the share of workers with a PhD in the South Australian defence industry was 3.7 percentage points above the national average. Tertiary education, heritage activities, and water supply, sewerage and drainage services (0.8 percentage points) were other areas of relative over-representation.

While an equal proportion of workers in South Australia had a doctoral degree compared to the national average in 2021, a different story applies for master's degree recipients: a much lower share of workers in South Australia had a master's degree compared to the national workforce (5.8 per cent versus 7.6 per cent). The higher national figure largely reflects that workers with a master's degree comprise a relatively larger proportion of the workforce in both New South Wales (9.1 per cent) and Victoria (8.8 per cent).

Differences in industrial structure between the states would in part explain South Australia's relatively lower share of workers with a master's degree. NSW and Victoria have above average shares of employment in sectors where master's degrees are most common including 'finance', 'professional, scientific and technical services', and 'computer system design and related services'.

However, differences in industry structure do not fully account for the lower degree of workers with a master's degree observed for South Australia. The state had a lower share of workers with a master's degree across almost all industry subdivisions.

Innovation Occupations

Figure 19 shows South Australia's share of the national workforce for the key innovation occupations. The state was home to 5.8 per cent of the science and innovation workforce in 2021, which was below the state's share of all employed persons (7.0 per cent). As a result the capacity of the state to produce and implement new ideas, and to capture existing ideas and technology from the rest of the world, is diminished.

When measured against their relative shares of the total national workforce, the research workforce tended to be over-represented in New South Wales (33 per cent), Victoria (28 per cent), and the Australian Capital Territory (3.5 per cent), and under-represented in Tasmania (1.4 per cent).

South Australia's deficit in the innovation workforce is relatively substantial. If we were even able to reach the national average, there would be 7,000 more South Australians employed as scientists, computer programmers, and engineers today.

If we were to achieve the concentration of workers in innovation occupations seen in NSW or Victoria there would be 10,000 more South Australians employed in these occupations.

South Australia has innovation workforce strengths in the areas of agriculture, food, agribusiness, and electronics, with employment shares well above the state's population share.

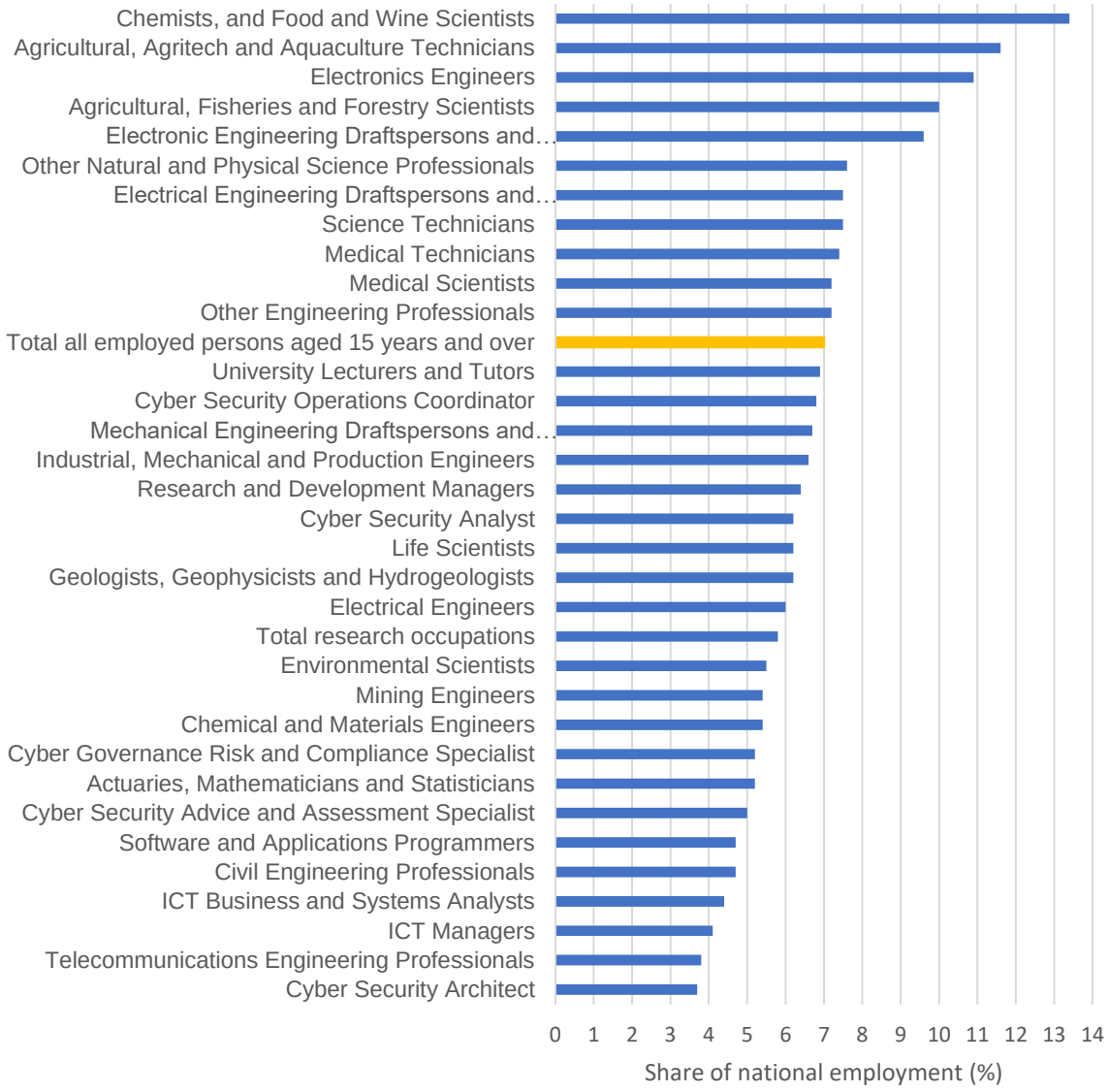
On the other hand, the occupational profile reveals some areas where South Australia has a notable gap in workforce capacity. In particular, information and communications technology (ICT), cyber security, and programming occupations are poorly represented within South Australia.

Finding 15: South Australia has a strong workforce in many key innovation occupations linked to state priorities. The general exception is in IT occupations, particularly cyber security, where the state's share of national employment is well below its population share.

Information request: Relative employment share of research occupations

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether relative employment shares in research occupations represent a useful indicator of relative strengths and weaknesses for the state around business innovation?

Figure 19: Key innovation occupations, SA share of national employment, 2021



Source: ABS (2021), 2021 Census - counting persons, place of usual residence, [Census TableBuilder], accessed 15 February 2023

Looking at the research workforce strengths that exist in other states (to be detailed in forthcoming supplementary data analysis):

- New South Wales has a well above average share of people who work as ‘actuaries, mathematicians and statisticians’ given the concentration of finance and insurance activities within the state. It also has major workforce depth in terms of ICT, cyber security, and software programming occupations.
- Victoria also has considerable research workforce depth in terms of cyber security and software programming. The state also has a well above average share of people who are employed as ‘telecommunications engineering professionals’, ‘chemists and food and wine scientists’, and ‘medical scientists’.
- Queensland appears to have limited strengths compared to other states in terms of employment of major research focused occupations, with ‘mining engineers’ and

'electrical engineering draftspersons and technicians' being the main occupations that were represented at levels noticeably above the state's share of the national workforce.

- Western Australia naturally has major depth in respect of mining occupations, accounting for around two-fifths of 'mining engineers' and 'geologists, geophysicists and hydrogeologists' respectively.

2.4 The role of research institutions in business innovation

In some regions universities are a critical element of their local innovation ecosystems, acting as a source of ideas, a key mechanism for drawing international best practice into the local economy, and an important source of new innovative firms through spin-outs and start-ups with founders drawn from the staff and students of the university. In other regions the connections between universities and their local business sector seem weak, with the main impact of universities being their role in supplying skilled labour.

An important part of this is the match between university research effort and parts of the local business community with the absorptive capacity necessary to draw in innovations.

Different approaches to management of IP; allocation of time to applied, business-focused research; and factors taken into account when considering academic staff for promotions can all have an impact on the impact of universities on local business innovation.

Equally, universities that are located in a region with an innovation-active business community are more likely to find potential partners with sufficient absorptive capacity and have a greater economic impact as a result.

Proximity between universities and potential business partners is critical, but importantly proximity does not mean co-location, but rather being located in the same city holding similar values and understandings, and facing similar incentive.

There is good evidence that **proximity** is a critical factor in enabling university business links. Despite the increasing use of digital technologies to meet collaborators and colleagues across the world, there are still strong geographic patterns to the locations of industry and to university business collaborations.

But importantly, proximity here doesn't mean being located in the same building or even the same city block. Instead the point at which distance starts being a *barrier* to effective collaboration is when it is no longer efficient to meet face to face from time to time. Empirical studies find that distance only becomes a barrier to collaboration when the university and the business are more than 25 to 30 km apart.[21] This suggests that 'place based' policy such as narrowly defined innovation districts are unlikely to be provide significant additional value, and that resources should instead be focused on building relationships between university researchers and businesses located in their city.

[21] National Institute of Economic and Social Research (2021), From Ideas to Growth: Understanding the drivers of innovation and productivity across firms, regions and industries in the UK, BEIS Research Paper 2021/041, Department for Business, Energy, and Industrial Strategy; Atta-Owusu, K., R. Dahl Fitjar and A. Rodríguez-Pose (2020) 'What Drives University-Industry Collaboration: Research excellence or firm collaboration strategy?', CEPR Discussion Paper DP14565; Delorme, D. (2023) 'The Role of Proximity in the Design of Innovation Intermediaries' Business Models', *Technological Forecasting and Social Change*, 188; Bertoletti, A. and G. Johnes (2021), 'Efficiency in University-Industry Collaboration: an analysis of UK higher education institutions', *Scientometrics*, 126, pp. 7679-7714; OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66, pp. 48-50

Finding 16: International evidence suggests that whilst geographical proximity is important to university-business links around research and innovation, geographical proximity in this context means being located within 25 to 30 km, not co-location.

Delorme (2023) goes further and suggests that proximity in the context of university business links should be thought of as having five dimensions:

- Geographical proximity;
- Cognitive proximity – similarity of knowledge bases;
- Social proximity – personal connections between academics and those working in business, allowing trust to develop;
- Institutional proximity – similarity of workplace norms and values; and
- Organisational proximity – similar regulations and incentives across the organisations.[22]

Again, this suggests a very different set of policy priorities than a model of proximity that focuses on co-location. Efforts should be targeted at better aligning incentives and norms across organisations, facilitating interpersonal connections, and identifying researchers and industry contacts with similar knowledge bases, including common focuses on specific underpinning technologies.

This is not to say that co-location is never important; given that there is good evidence that co-creation/joint research is a really important form of collaboration there needs to be sufficient spare space capacity and facilities in research organisations to enable industry partners to temporarily co-locate, jointly access research infrastructure etc. This also requires an organisational openness to this type of model of collaboration.

Finding 17: Proximity – understood broadly to encompass similar values, norms and technological understanding as well as geographic closeness – is the most important factor in successful business industry collaborations.

Talent is the key, to university business collaboration and to innovation more generally

People, and their ability to transmit tacit knowledge, are the source of research spillovers generally, and the impact of research institutions in particular. This means that any set of policies aimed at strengthening the research business relationship around innovation needs to be primarily focused on talent: how it can be grown, how it can be fostered, how it can be attracted and how it can be retained.

Some of this is the traditional movement of graduates and post-graduates out into businesses. But less traditional movements can be incredibly effective, e.g. academics temporarily working in firms and industry researchers working in universities. It is important that university human resources (HR) and intellectual property (IP) policies facilitate this.

Finding 18: Innovation at its heart is about talented people, and talented people rather than buildings need to be the focus of future innovation policy

The role of universities in driving innovation is not purely a STEM story.

Most of our economy is services, and whilst there are a number of STEM based enabling technologies that are likely to be important for services, much of the innovation they need

[22] Delorme, D. (2023), *Op cit*, p. 2-3

will draw on social sciences and humanities. Most significant channel for these collaborations are likely to be the output of graduates and post-graduates. But commercialisation activities shouldn't ignore non-STEM academics as an important source of ideas.

And as a partially corollary of this, the important skills for commercialisation are not just technical but also entrepreneurial. Building entrepreneurial education and experiences into the post-graduate (and possibly undergraduate) curriculum across university faculties and making such education available to those academics who are interested, is likely to be an important enabler of university business collaboration.

Finding 19: Successful commercialisation of research doesn't only depend on great science or engineering; it also needs a range of non-STEM skills.

Incentives and structures need to be aligned to objectives

The OECD, in reviewing university business collaborations[23], concludes that successful programs designed to support technology transfer entail a combination of different financial instruments and soft instruments. The programs also require a regulatory framework that enables researchers to engage in such activities and provides them with incentives.

The OECD found a major challenge to be that only a small proportion of technology transfer projects leads to substantial economic impact in terms of income and jobs. The challenge is to scale-up the most promising projects, including to international markets, rather than just increasing the total number of spin-offs and patents generated.

Fragmentation of innovation ecosystems was consistently identified as a barrier to successful collaboration. The fragmentation can lead to overlapping activities, an unclear presentation of the sector for industry engagement and a misallocation of research and education potential. The analysis points to a profusion of initiatives, instruments, regulations, mechanisms, and institutions lacking direction and coherence.

Cooperation between business and researchers is widespread but focuses on smaller projects and applied R&D. The overlap of university and public research institute research activities can create inefficiencies. Contribution to knowledge transfer has been lower in emerging areas (technology or markets) and has concentrated on established links and industry structures. Related to this is that there are few incentives (such as innovation vouchers) to encourage firms to reach out to PRIs for the first time. Businesses that have participated in research collaboration either on thematic research programs or on a project basis have observed that these arrangements often suffer from mismatches generated by high-level abstraction of agenda-setting processes and the more concrete aims and interests of businesses.[24]

Use of intermediaries between universities and business is almost universal, but there is very substantial variations in the types of intermediaries used

All advanced innovation ecosystems have one or more sets of intermediaries between research institutions and potential end-users of research, but these can take a number of

[23] OECD (2019) *Op cit*
[24] OECD (2019), *Op cit, Plewa, C., T. Darney, A. Meerman and V. Galán-Muros (2017), 'The State of Australian University-Business Cooperation (The Business Perspective)'*

forms and have a range of focuses. Research undertaken by the OECD[25] identifies a wide range of models used in its member economies, all of which can be broadly categorised base on their delivery of one or more of the following types on intermediation:

Knowledge managers

- Research production (undertaking primary research (new discovery) and/or secondary research (translating research undertaken elsewhere into the local context);
- Research dissemination and advocacy (communicating the results of research, though mechanisms such as websites, newsletters, forums and practice guidelines);

Linkage agent

- Relationships and network building (undertaking events, presentations and facilitating networking and collaboration agreements);

Capacity builder

- Individual skills and capacity building (delivered through workshops, training courses, seminars and public lecture series);
- Organisational and system development and capacity building (organizational development programs, leadership development programs, coaching, mentoring);

Transversal

- Research use and intervention support (through meeting plans, guidelines for interventions, implementation coaching and mentoring, funding proposals of intervention support)
- Evaluation, scale-up and sustainability (monitoring plans, evaluation of outcomes and impacts, feasibility studies).

Given the specific limitations identified in South Australia's level of business R&D and innovation, and the engagement between researchers and business, intermediation functions targeted at research production, and organization and system development and capacity building are likely to be most immediately useful. Many of the other intermediation approaches are structured to build on a base of engaged business users of innovation.

A number of jurisdictions have created specific research bodies focussed on delivering the transmission of knowledge from research institutes to business outside of traditional university structures by undertaking joint research with businesses. Three such examples are described in Box 1.

[25] Torres, J. M. and M. Steponavičius (2022), 'More than just a go-between: the role of intermediaries in knowledge mobilisation', OECD Education Working Paper No. 285

Box1: Three successful models of research focused intermediaries

Fraunhofer-Gesellschaft – Germany

The Fraunhofer-Gesellschaft is an applied research organisation in German that undertakes applied research and development activities to foster innovation. The Fraunhofer identifies innovative fields of business and trending technologies with significant market potential and relevance to society and further develops them through in-house research programs.

The Fraunhofer operates 76 research institutes across the country. Each institute develops its own fields of business and core areas of expertise based on market needs and its links with the scientific community. The institutes are organized into nine groups, based on their areas of expertise, namely:

1. Energy Technologies and Climate Protection;
2. Health
3. ICT Group;
4. Innovation Research;
5. Light & Surfaces;
6. Materials and Components;
7. Microelectronics;
8. Production; and
9. Resource Technologies and Bioeconomy.

Additionally, the institutes with different areas of expertise work together in Fraunhofer alliances to coordinate targeted cross-institute knowledge transfer activities.

The Fraunhofer has over 30,000 employees, comprising mostly of scientists and engineers. Interdisciplinary research teams work with industries and governments to turn new ideas into innovations, and coordinate and implement applied research projects. International collaboration brings Fraunhofer into direct contact with leading researchers and companies that are driving scientific progress and innovations.

Fraunhofer's income is derived from base funding from federal and state governments, from its own activities primarily through contract research, and from other revenue sources. In 2021, Fraunhofer's annual income was €2.9 billion, of which €2.5 billion were generated from contract research (the organisation's main business activities). Contract research comprises three areas: (i) Research directly contracted by industry; (ii) Publicly funded research projects; and (iii) Pre-competitive research financed through base funding. About two thirds of contract research income comes from industry contracts and publicly funded research projects, and the remaining one-third comes from the federal and state governments in the form of base funding. The Fraunhofer also receives additional research funding for long-term research activities that fall outside the scope of regular base funding.

The Fraunhofer Institutes operate as separate profit centres, but they are not autonomous legal entities. The institutes are evaluated every five years by independent experts. If an institute is underperforming, then the organisation will develop measures to help improve its performance. When an institute is performing well, it will receive the funding from the organisation to implement its strategy.

Fraunhofer Institutes help strengthen firms' performance and efficiency and promote the acceptance of new technologies in the society. For instance, three of its most notable inventions are mp3, white light-emitting diode LED, and the world's most efficient solar cell. Fraunhofer Institutes also train future scientists and engineers to drive innovation in the economy.

Catapult Network – UK
Catapults are independent, not-for-profit organisations in the UK that provide firms and academia access to technical expertise, skills, infrastructure, and equipment to help commercialise their innovative ideas and research. There are currently nine Catapults in the country, established between 2012 and 2013, namely, Cell and Gene Therapy; Connected Places; Compound Semiconductor Applications; Digital; Energy Systems; High Value Manufacturing; Medicines Discovery; Offshore Renewable energy; and Satellite.

Catapults receive their funding from three main sources: government grants, commercial work, and collaborative R&D (CR&D) activities. In principle, the funding arrangements should be a third from each of these components, similar to the Fraunhofer's funding model. In practice, the actual composition is titled towards government funding for most Catapults.

Catapults have a five-year funding agreement with the UK Government (through Innovate UK) to deliver an agreed set of KPIs. As part of the monitoring process, the Catapults provide quarterly report to Innovate UK, which assesses against key performance indicators. The budget for the nine Catapults for the period 2018-2023 totalled £1.17 billion.

In addition, UK Innovate has conducted several reviews (2014, 2017, and 2021) of Catapults' operations to assess their performance and identify areas for improvement. The 2021 review found that:

- Catapults' activities have had a positive impact on business innovations in the UK and that the Catapults have played an important in the UK's innovation ecosystem. For example, the High Value Manufacturing Catapult's FutureForge facility helps firms explore less energy intensive forging methods, and the Offshore Renewable Energy Catapult's test facility provides research, test, innovation and validation services to accelerate the deployment of offshore renewable energy technologies.
- There is a correlation between the age of the Catapult and its performance in leveraging business investment in R&D, which suggests that it may take more than 10 years for a Catapult to mature.
- Catapults' relationships with universities vary. Some catapults collaborate more closed with certain universities, while other catapults collaborate with universities on an ad hoc basis.
- Catapults need to engage better with universities so that they can identify and test the feasibility of innovative ideas before a product or technology can be developed.
- Catapults' networking and business advice has encouraged new partnerships.
- There are opportunities to improve collaboration and knowledge sharing across the Catapult Network, such as reviewing the funding rules to provide greater flexibility for Catapults to collaborate on projects of mutual interest.
- Catapults could work with industry, schools, and higher education institutions to help close the emerging skills gaps, such as through studentships, apprenticeships, and outreach programs.

The Technology Access Centres – Canada

The technology Access Centre (TAC) grants are one of several types of grants under the College and Community Innovation (CCI) Program that helps Canadian colleges increase their capacity to collaborate with local firms (mainly SMEs) and non-profits or public organisations to foster innovation. This program is administered by the Natural Sciences and Engineering Research Council of Canada (NSERC).

The TAC grants support the core operations of Technology Access Centres (TACs). A TAC is an applied research and innovation centre affiliated with a Canadian college that specialises in a particular field of expertise of economic importance to the region that it is located. TACs facilitate SMEs' access to college expertise, technology, equipment, and TAC network to meet their applied research and innovation needs. TACs do not compete with services provided by the private sector. Currently, there are 60 TACs in Canada.

TAC grants are renewable every five years, with a maximum amount of up to $100,000 per year for colleges in Quebec, and $350,000 for colleges in the rest of Canada. The annual funding for TAC grants from the Government of Canada was around C$13.5 million in 2018.

TAC grants have had a positive impact on the innovation capacity of client firms and the TACs. The evaluation of the CCI Program conducted by NSERC in 2018 found that (i) the suite of grants offered through the CCI Program is increasing the capacity of colleges to undertake applied R&D; (ii) SMEs are increasingly engaging colleges to undertake applied R&D; and (iii) about a third of TAC surveyed client firms (that had completed an applied R&D or technical and business service project) indicated that their revenues increased.

Additionally, Tech-Access Canada (the national network of TACs), which collects annual performance indicators and applied research metrics from each TAC, finds that during 2016-17, TACs provided 5,661 specialized technical service engagements to client firms and partnered on 1,197 collaborative applied research projects. The engagements resulted in 793 new or improved products and processes. Moreover. TACs leveraged over C$36 million of business innovation investment from external collaborators, C$20.2 million of which came from client firms. This is about five times higher than the Government's investment in TACs in 2016-17.

Finding 20: Research focused models of intermediation aimed at building proximity between research and business, such as the Fraunhofer Gesellschaft, the UK Catapult network and the Canadian Technology Access Centres appear most likely to address the limitations identified in South Australia's innovation activity.

3. Making Universities the Engine of our Transition to a Dynamic, Complex Economy

Given the relatively low level of private sector R&D, the extent to which firms are focussing on incremental, inward-looking innovation, and the predominance of very small firms in the state (see Chapters 1 and 2) our conclusion is that South Australia will need to look to our universities to drive productivity enhancing innovation, at least initially.

Achieving this will require improving the engagement between universities and business to:

- help existing, innovation intensive firms innovate even more successfully and grow even faster,
- help shift existing firms that have the potential to become high growth innovative firms, and
- to create more innovation intensive/high-growth firms in the state by increasing the rate to start-ups, increasing the chance that start-ups will be able to scale up in SA, and attracting in innovative firms.

Our focus on the delivery of policy support relatively early in the innovation process is based a view, formed through this review, that economies that have vibrant innovation ecosystems generating novel, commercially viable new products and services do not struggle to attract investment to scale up these firms. Nor do they struggle to gain access to international markets. The barriers to local business success tend to happen at the earlier stages of the invention and commercialisation process. And that is where support should be directed.

However, there are a number of barriers to achieving international best practice in the relationship between universities and the business community. This exist at both the university and the business sides of the relationship. However, as noted above, our conclusion is that initial work should be focused on the universities.

Suggested reforms

The broad thrust of our suggested reforms is based around the idea (outlined by Delorme and others, see section 2.4) that the success of university business collaboration will be driven by a broad set of proximities. Given the geography of Adelaide geographic productivity is generally not a problem, with most potentially innovative businesses located within 25 to 30km of one of the research universities. Instead, our suggestions focus on the other dimensions of productivity:

- Cognitive proximity – similarity of knowledge bases;
- Social proximity – personal connections between academics and those working in business, allowing trust to develop;
- Institutional proximity – similarity of workplace norms and values; and
- Organisational proximity – similar regulations and incentives across the organisations.[26]

Organisational proximity, particularly around aligning the incentives of researchers and business, can be improved through reforms to the equity share required by universities in commercialising IP (section 3.1.1), shifting business impact to be a core objective of universities (section 3.1.2), and by reforming university performance management and

[26] Delorme, D. (2023), *Op cit*, p. 2-3

promotion processes so that academics with skills and interest in industry engagement can be appropriately rewarded for the effort they put into it (section 3.1.3).

Cognitive proximity can be improved by ensuring all researchers have at least a basic knowledge of entrepreneurialism (section 3.1.4), and through the outreach functions of the proposed Critical Technology Applied Research Institutes improving knowledge amongst the business community of the capabilities of the state's universities (section 3.3).

The Critical Technology Applied Research Institutes will also have an important role in improving **social proximity** through their business outreach functions, complementing existing work being undertaken in that 'public square' role. The Critical Technology Applied Research Institutes should also help to improve **institutional proximity** between university researchers and businesses engaged in co-discovery.

Finding 21: Our conclusion based on the evidence presented in this draft report is that reform is required amongst the universities to position them to fulfil their potential as the engines of South Australia's innovation system

The barriers at the university side don't exist because universities are not aware of the benefits of industry collaboration, nor do they reflect poor implementation by universities. Instead, the focus of university activity on teaching and on peer-reviewed research are a response to the incentives they have been given.

If, as a state, we want universities to sharpen their focus on industry engagement we will need to change the incentives the universities, their researchers, and their students, face.

A potential model for shifting these incentives is the national competition policy introduced by the Keating government in 1993. This was set up to facilitate a number of competition-enhancing national reforms that required changes at the state government level. As most of the potential benefits of the reforms would flow to the national economy the reform process included a set of payments to the states if they implemented the reforms. These were administered from within the Australian Competition and Consumer Commission.

Finding 22: Implementing these suggested reforms would not be costless for the universities, and whilst we believe they would deliver benefits for the universities, the lion's share of the benefits will flow to the state more broadly. This means that it may be reasonable for the universities to be provided with financial support to facilitate the reforms being requested.

This funding should only be disbursed on agreed progress towards implementing the reforms.

Information request: Providing universities with incentives to reform

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on what types of incentives and support to universities would be most compatible with engaging them in the reforms canvassed in this chapter.

The Commission's current inquiry in early 2023 is being undertaken against the backdrop of South Australian Government facilitated discussions about a potential merger between the University of Adelaide and the University of South Australia.

The potential implications to a university merger were not included in the Commission's terms of reference for this inquiry and so the Commission is unable to form a view on the relative merits of a merger.

However, we would note that a merger, if designed and implemented competently, could create a catalyst for broader cultural change in the merged institution making some of our suggested reforms more likely to succeed. The merger could also potentially create cost savings for example through removing duplications of assets enabling more efficient use of facilities. If any such savings were used to fund applied, industry focused, research in the spirit of our reforms then the potential for the universities to drive improvement in the state's economy would be further enhanced.

3.1 Recommended university reforms

3.1.1 Equity shares in commercialisation and inventor incentives

Successful commercialisation of research through a start-up requires significant on-going involvement from the inventor(s)

A significant share of start-ups have at least once founder who is a university staff member, or a current university student. The average is around 15 per cent across the OECD and around 23 per cent of start-ups in high tech fields such as biotechnology[27]

But university staff need the right incentives to participate, as start-ups will typically only work if the key inventors retain a substantial involvement in their commercialisation (e.g. acting as CTO), but equally useful to have key inventors willing to step back and let the CE role be undertaken by a manager.

Student led start-ups are very important for volume, although they are less likely to involve genuinely disruptive technology than research led start-ups, but are generally much less of a policy focus and receive much less support.

Australia has a below average rate of researcher start-ups, a broadly average level of start-ups with at least one PhD as a founder, and an above average rate of student founded start-ups.[28]

A number of international reviews, including the OECD's study into university-industry collaboration, and the Scottish technology ecosystem review, have highlighted concerns from venture capital investors that University equity stake around 50 per dilutes the incentives of inventors to work on the commercialisation of their technology, reducing the chance of successful spin-outs, and making venture capital funds less likely to invest. [29]

Current standard university equity shares risk diluting the incentive for on-going participation by inventors

Standard practice across all three South Australian universities is for the university to take a 50 per cent equity stake in spin-outs and start-ups that involve IP developed at the university. It is not possible to identify the revenue received by the three South Australian universities from start-ups in their public accounts. However total revenues for 'royalties, trademarks and licences' of suggest that commercialisation of IP is a very small share of

[27] OECD (2019) Op Cit
[28] OECD (2019), Op cit, p. 53
[29] OECD (2019), Op cit, Logan, M. (2021) 'Scottish Technology Ecosystem Review', An independent review commissioned by the Scottish Government.

university income (see Table 5). In 2021 total IP income was 0.3 per cent of total income for the three universities.

Table 5: Total revenue for royalties, trademarks and licences by university, $'millions.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Flinders University	0.6	0.5	1.0	3.0	1.3	0.7	0.6	0.8	0.8	0.2
University of Adelaide	3.9	4.8	4.9	4.7	3.9	7.9	6.0	4.6	4.8	6.7
University of South Australia	0.4	0.3	0.3	0.2	0.5	0.4	0.4	0.5	0.5	0.5
Total	5.0	5.7	6.3	7.9	5.7	9.0	7.1	5.9	6.1	7.4

Source: annual reports of Flinders University, University of Adelaide, University of South Australia.

Some leading commercially focused universities internationally have adopted policies which involve much smaller shares of IP accruing to the university – Stamford typically takes 10 per cent and MIT 5 per cent. Stamford and Imperial College London each vary the required equity stake based on the level of pre-incubation and follow-on support provided by the University.[30]

Adopting a similar position in South Australia could increase the number of start-ups created and increase their chance of scaling-up and securing venture capital funding and is unlikely to lead to a significant loss in revenue. Where incubation support, or seed funding, have been provided by the university it could take a higher equity share, depending on the nature and extent of support provided. (For example, the Y-Combinator incubator in the US, probably the best known private sector start-up incubator, takes a 7 per cent equity share in participants in exchange for incubation services and a US$125,000 seed investment.[31])

Finding 23: South Australian universities' default equity shares appear to be too high, and adopting a lower standard share could increase rates of scale-up and VC funding for start-ups with university researchers as founders.

Information request: University equity shares in start-ups

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether the current standard equity share taken by universities in start-ups commercialising IP developed at the university reduces the incentives for researchers to participate in the commercialisation of research? And does it reduce the willingness of venture capital funds to invest in these start-ups?

3.1.2 Make impact and engagement one of the central statutory objectives of our universities

Internationally, discussions about the role of universities are increasingly referencing a tripartite focus on teaching, research and engagement as part of their social license.

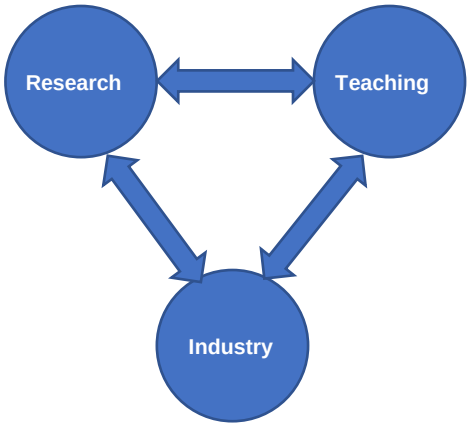
Internationally, discussions of the role of universities and other research institutions have increasingly emphasised engagement with industry and with social problems, often as part of a broader discussion around the 'social licence' for the university to enjoy its typically privileged status in the local innovation system. For example, in the OECD review of

[30] Logan (2020), Ibid, p. 33-34
[31] Y-Combinator (undated): https://www.ycombinator.com/deal/, accessed 06 March 2023.

university industry collaboration[32] most participating countries referred to the **third mission** of research institutions, namely engagement with other sectors such as firms and the issues of society and economy (after research and education). The OECD notes that many European nations are explicitly building capabilities within their research institutions to address society's challenges, to orientate resources to radical and globally leading innovation and to facilitate knowledge transfer in paths that are not well established yet have significant economic potential.

Similarly, the review of the Scottish technology ecosystem[33] notes that:

> *The best universities view industrial collaboration in general, and start-up facilitation in particular, as equally important to their other missions of teaching and research. They understand that it is difficult to be genuinely world-class in teaching and research without being world-class in industrial liaison and entrepreneurial support. With any of these missing the others are diminished.*



(p. 29)

This is not yet, at least formally, the case in South Australia. The state's public universities are incorporated under state legislation, with each institution established by its own enabling Act. The enabling statutes provide for the creation, continuation and administration of each university and set out key governance arrangements, including the composition and responsibilities of the universities' governing councils. In addition, the enabling statutes specify that the universities are not instrumentalities of the Crown and that each institution, as a body corporate, is invested with full juristic capacity and possesses unfettered discretion to conduct its affairs as it deems fit (subject to all applicable law).

That said, although they are not instrumentalities of the Crown, the universities are subject to two statutes that also bind state government agencies, the *Freedom of Information Act 1991* (SA) and the *Public Finance and Audit Act 1987 (SA)*. The universities' annual financial reports are audited by the South Australian Auditor-General, subject to the *Public Finance and Audit Act 1987* (SA). All three institutions are registered charities under the applicable Commonwealth statutes.

[32] OECD (2019), *Op Cit*
[33] Logan (2020), *Op Cit*

Existing statements of objects and purpose for South Australian universities emphasise the traditional dual teaching and research role of the institutions.

University of Adelaide

The university's statutory object is defined at a relatively abstract level:

> The object of the University is the advancement of learning and knowledge, including the provision of university education.[34]

The enabling Act does not add any additional detail to, or provide further clarification of, the university's objects or functions, but endows the governing council with the power to approve the university's strategic direction and mission.[35]

Flinders University

Flinders University's enabling Act provides a more developed and detailed set of functions:

> The functions of the University include, within the limits of its resources—
>
> (a) the provision of educational facilities at university standards for persons who being eligible to enrol seek the benefits of such facilities; and
>
> (b) the establishment of such facilities as the University thinks desirable for providing courses of study, whether within the University or elsewhere, for evening students, giving instruction to and the examination of external students, and providing courses of study or instruction at such levels of attainment as the Council thinks appropriate to meet the special requirements of industry, commerce or any other section of the community; and
>
> (c) generally, the dissemination of knowledge and the promotion of scholarship.[36]

The Act, in common with the University of Adelaide's enabling legislation, provides the university's council with the power to "approve the mission and strategic direction of the university…"[37]

University of South Australia

The University of South Australia's enabling legislation requires the university to pursue a comprehensive, and interconnected, set of primary functions:

> (1) The functions of the University are as follows:
>
> (a) to preserve, extend and disseminate knowledge through teaching, research, scholarship, consultancy or any other means; and
>
> (b) to provide tertiary education in such disciplines and areas of study as the University thinks appropriate to meet the needs of industry, commerce, the professions or any other section of the community; and

[34] *University of Adelaide Act 1971* (SA), s 3.
[35] *University of Adelaide Act 1971* (SA), s 9(1)(b)
[36] *Flinders University Act 1966* (SA), s 4.
[37] *Flinders University Act 1966* (SA), s 5.

(c) to provide such tertiary education programmes as the University thinks appropriate to meet the needs of the Aboriginal people; and

(d) to provide such tertiary education programmes as the University thinks appropriate to meet the needs of groups within the community that the University considers have suffered disadvantages in education; and

(e) to provide educational programmes for the benefit of the wider community or programmes for the enhancement of the diverse cultural life of the community, as the University thinks fit; and

(f) to foster and further an active corporate life within the University; and

(g) to perform any functions that are ancillary or incidental to the functions referred to in the preceding paragraphs.

(2) The University must strive for excellence in teaching and research and for attainment of the highest standards in education.[38]

In common with the enabling legislation of the other public universities, the University of South Australia's constituting Act provides that the university council has the power to approve the university's strategic direction and mission, subject to the statutory functions outlined in section 5 of the *University of South Australia Act 1990* (SA).

A number of leading international institutions have objects that encompass a broader set of impacts, and could serve as models for amendments to the relevant Acts to properly reflect the Universities' social license obligations to the South Australian economy and households.

Finding 24: None of the three South Australian universities have economic or social impacts in the state included as part of their purpose and objects under the relevant Acts.

Information request: Objects and functions of South Australian universities

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether expanding the objects and functions of each of the South Australian universities in their relevant Acts would be a useful way of embedding a broader focus on contributions to industrial outcomes as part of their 'social license', or would it make little practical difference.

3.1.3 Ensure academics can get recognition for engagement

Human resources policies in universities, including allocation of time between functions, and the factors considered in applications for promotion are driven by the overall priorities of the university. The OECD in its review of university industry collaboration notes that there are widespread issues across its member economies with academic career paths limiting the incentives for industry collaboration and commercialisation of research. This includes:

- limited or negative incentives for researchers to engage and support knowledge transfer activities, as research evaluations focus on peer-reviewed publications.

[38] *University of South Australia Act 1999* (SA), s 5.

- lack of incentives for academics to invest time in the intermediate stages (such as validation and readiness) of start-ups commercialising their research due to high university equity shares (see 3.1 above); and
- time allocated to collaboration by academics with industry is insufficient as universities grant insufficient work time. Additionally, academics perceive that university-business collaboration conflicts with their teaching and research responsibilities.

Notably, the University of South Australia has recently taken steps to try and address the promotions related barriers to academic engagement with industry, by allowing academics to nominate whether they want to be assessed on their research quality or the community engagement in setting performance indicators for them. This seems an excellent approach as it allows academics to focus on what they individually do best. An academic who is exceptional at 'pure' research but struggles with industry engagement can nominate research quality measures and a researcher spending time engaging with industry can get recognition for that (and avoid being penalised for the lower research output) by nominating engagement based performance measures.

However, to truly incentivise industry engagement around research, workload models will also need to be set so that industry engagement (at least by some researchers) is supported through adequate allocation of time away from teaching and peer reviewed research.

Finding 25: The South Australian Government should encourage the other universities to adopt the University of South Australia's approach of allowing academics to choose between research quality and engagement performance indicators. The three universities should also be supported to revise their workload models so that industry engagement can be sufficiently resourced.

Information request: Providing academics with recognition for engagement

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether the type of model outlined here is a workable model for supporting those academics who wish to prioritise industry engagement, whilst not reducing the incentives for research quality across the university?

3.1.4 Build and reward entrepreneurial skills across university students

The importance of embedding entrepreneurial education within universities, and teaching it in a way that brings together students (particularly post-graduate students) across different faculties, is one of the most important sets of recommendations of the review of the Scottish technology ecosystem. The review considers that delivering entrepreneurial education to post-graduate (and possibly undergraduate) students across universities regardless of their faculty, and teaching these students in joint classes to build links between students with different skill sets, is the intervention most likely to build a self-sustaining start-up ecosystem in Scotland. This increase in education would need to be supported through increased availability of incubation services and other early forms of support. The rationale for this focus is that higher levels of start-up formation (and successful scale-up) will require a wider range of research students and academics with entrepreneurial skills, and will need more extensive collaboration between students of 'technical' disciplines and students of business, and social science disciplines.

Good practice in university activities to support entrepreneurialism identified by the Scottish Technology Ecosystem Review[39] include:

- Entrepreneurial education is widely offered by the university, at a number of levels and in a number of formats from full semester courses to short courses;
- Entrepreneurialism education is delivered in a cross-disciplinary way with business and technical students taught together;
- Students perceive that the university values entrepreneurialism;
- Students are encouraged to explore start-up ideas, and are given access to facilities and supports to help them do so;
- Universities are adequately resourced to support their students in entrepreneurialism;
- Computer science [and ICT more broadly] students are taught tech start-up leadership skills as part of their degree;
- Incubation space (and, potentially, seed investment funding) are available to high-potential student founded start-ups.

To their credit, each of South Australia's three research universities have significantly expanded the extent of their entrepreneurial education and opportunities over the past decade or so. There are indications that these changes have led South Australia's universities to be amongst the best in the country at entrepreneurial education.

However, it is our judgement that universities need to do even more on entrepreneurial education, facilitation and support of start-ups, and facilitation and support of scale-ups if the three universities are to realise their potential as drivers of the state's innovation. In particular they need to find a way to take the high-quality existing teaching practice around entrepreneurship (and entrepreneurship competitions currently run on a relatively small scale) and make them much more extensive.

The ultimate goal should be that every higher degree by research student should receive entrepreneurship training as part of their program. Entrepreneurship competitions would also be expanded in their scale, and a larger number of the most highly ranked entries would be provided with accelerator and incubator support to test whether the idea can be commercialised.

The University of Waterloo in Canada is a good model for an institution with a focus on providing extensive entrepreneurship education and support to its students.

Finding 26: Entrepreneurship education should be provided as a compulsory subject in higher degree by research courses in South Australia. Similar courses should be offered as options to undergraduates across all faculties.

Information request: Entrepreneurship education and support

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether it would be feasible to extend the delivery of entrepreneurship education to the extent envisioned? And if feasible, is such an increase in entrepreneurship education likely to lead to a large enough increase in entrepreneurial activity by students to make it worthwhile?

[39] *Logan, M. (2020) Op cit*

3.3 Critical Technology Applied Research Institutes: a new model for joint research and knowledge sharing with industry

South Australia needs a new model for translating research from universities to industry

We believe that meeting the challenge of translating the knowledge generated in our universities into economic opportunities for the state will require an entirely new type of institution for the state. In the past a number of models focused on business development and commercialisation have been tried in our universities without any evidence of sustained impact.

The proposed model is based around applied researchers specifically employed to co-design and deliver research with industry to address industry problems using critical technologies.

International evidence suggests that the most effective approach to achieving the 'proximity' between researchers and industry needed for effective translation of knowledge is actually undertaking joint research with industry. The German Fraunhofer Gesellschaft, the UK Catapult Network, and the Canadian network of Technology Access Centres are all successful models of this type of translation model that we have drawn on. Locally some elements of AIML also reflect this approach.

We recommend the establishment of a network of Critical Technology Applied Research Institutes, initially wholly funded by the state government, but with the expectation that industry and Commonwealth Government funds would increasingly contribute over time.

Each Critical Technology Applied Research Institute would:

- Be focused on a single critical technology (such as quantum computing), or key societal need (such as the green energy transition). This would allow it to build credibility with partners and achieve a deep understanding of the technology and its uses.
- Selection of potential technology areas/key societal needs would be based on the areas' long-run economic potential and the potential for local industry engagement around innovation.
- Undertake applied, industry focused, research itself as well as undertaking collaborative research with key industry and academic stakeholders (particularly in TRLs 2 to 6).
- Have its own core team of active applied researchers, with an emphasis on creating opportunities for early career researchers.
- Have a significant industry engagement focus, with the applied researchers expected to spend time engaging with industry to identify potential industry partners, and then work with them to identify whether there are ways for the critical technology to help address business problems they face. CTARIs would need to engage with specialist training and support to assist researchers in fulfilling this objective.
- The CTARIs would need to have secure, long-term on-going government funding, without the expectation that they will eventually become entirely self-funding. Funding would be reviewed on a 5-yearly basis based on evidence of the impacts of the CTARI, or its progress towards the targeted impacts.
- Be based around a specific area of key academic strength in South Australia. and

- Be attached to one or more university, with research staff employed by the host university (to ensure a sense of ownership by the university).

Finding 27: South Australia needs a network of dedicated, technology specific, applied research institutes to help bridge the gap between universities and business.

Information request: Potential model for facilitating technology transfer out of universities

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether the type of model outlined here is likely to be an effective approach to significantly increase the extent to knowledge transfer out of universities in key technology areas? Or are there elements of the local innovation system that suggest this type of model is unlikely to be effective?

3.2 The university reform fund

Implementation of our recommended reforms will impose some costs on the state's universities, with most of the benefits flowing to the state as a whole. It is therefore reasonable that they should receive access to financial support for the reforms to ensure that incentives are aligned across universities, industry and government.

The scale of any such fund is a matter for the government.

We do, however, have several matters of broad principal which our analysis of other funding schemes suggest will increase the reform fund's prospects for success.

Funding should be explicitly tied to the implementation of the reforms, and only be disbursed in a given year if the agreed progress towards implementing the reforms has been met.

Administration of the fund should be as seamless as possible.

We are very conscious not to create yet another layer of bureaucracy for universities to navigate. We are also conscious that specific bodies can often develop a life of their own and begin to see themselves as central players in their area of policy.

In order to minimise this risk, we recommend that funding is:

- tied to specific purposes,
- allocated as a block grant once it has been determined that the required progress against the agreed upon reforms have been made in that year, and
- that existing public service structures be used to make the assessment and authorise the release of the funds.

The specific purposes of the funding should be tied directly to activities that will help support the universities in playing their role in the innovation ecosystem. In addition to the Critical Technology Applied Research Institutes, this could include co-investment support for activities such as providing 'seed' funding for start-ups commercialising university IP and supporting early career researchers.

Finding 28: Financial support to the SA universities to facilitate implementation of the suggested reforms should be tied to activities linked to university-industry collaboration and released in a way that minimises administrative burden.

Information request: Financial support for universities to facilitate reforms

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether the proposed funding allocation model and funding priorities would be workable?

3.4 Access to global entrepreneurial talent

International students provide an underutilised pool of potential entrepreneurial ideas and skills for South Australia. As a state we should be doing all we can to support them in commercialising their ideas here in South Australia. The recent introduction of the Business Innovation and Investment (Provisional) visa (subclass 188), Entrepreneur stream (188E visa) as a state nominated visa class means that there is now a visa available with a pathway to permanent residency (if the conditions are met) that is tailored for entrepreneurs, rather than high-net worth, experienced, business people. However, we have heard that processing delays, and a limited number of positions available to South Australia, have significantly reduced the scope for this visa to be used to retain international students and attract inward migrants with plans to develop start-ups in areas of state government priority.

Finding 29: The South Australian Government should work with the Commonwealth Government to secure a higher allocation of 188E visa places for the state, and to achieve more timely processing of 188E visa applications.

Information request: Importance of entrepreneurs as a target for migration

As the Commission moves towards developing the inquiry final report, the Commission seeks evidence-based feedback from the relevant stakeholders on whether entrepreneurs should be a high priority for state-sponsored migration? And whether international students studying in South Australia should be a focus for state-sponsored places in this visa category?

Appendices

Appendix 1: Notice of Inquiry and Terms of Reference

SOUTH AUSTRALIAN PRODUCTIVITY COMMISSION INQUIRY: TURNING RESEARCH INTO ECONOMIC COMPETITIVENESS FOR SOUTH AUSTRALIA

I, Peter Malinauskas, Premier, hereby request that the South Australian Productivity Commission (the Commission) undertake an inquiry into Turning Research into Economic Competitiveness for South Australia.

Background

South Australia's economy has been strong coming out of COVID, with solid economic growth over the last two years. Unemployment at 4.0 per cent (as at October 2022) is at a low that was last seen in South Australia in the mid-seventies.

However, this strong recent performance has not fixed the long-term structural economic challenges facing Australia. Strong increases in national incomes have not flowed through the income of Australians. A lack of complexity and diversity in the Australian and South Australian economy, holding back wages and productivity growth and leaving us vulnerable to a changing international environment.

We face a generational economic question, and that can only have generational solutions. Solutions that rest on a more skilled population, working in a diverse and growing knowledge rich economy and being rewarded with fair wages. This is why my Government is committed to raising the potential of the state's economy through:

- introducing expanded, world class early-childhood education;
- increasing the quality of education in schools; and
- reforming the University sector to help it to recover from the impacts of Covid, and to enable them to be the engine room of the state's economy.

There is much to be gained if we get this right, with significant opportunities in:

- supporting the global transition to net zero through green minerals produced using South Australia's abundant renewable energy resources;
- increased defence spending linked to the geopolitical context; and
- the opportunity to capture a share of the international trade in green hydrogen.

One of the causes of our low complexity, low diversity economy is the consistently low levels of innovation and dynamism in South Australian businesses. This inquiry will support my Government's work in beginning to build the future that we all seek by undertaking a forensic examination in ***how research is turned into increased competitiveness*** for our state, including:

- the importance of research and knowledge diffusion for economic competitiveness;
- the effectiveness of current links between research institutions (including universities) and business, and of government programs supporting research and innovation; and
- what the State Government can do (including in collaboration with others) to help bridge the gap between the generation of knowledge and those who could put it to use.

Terms of reference

The Commission is asked to consider and report on:

1. The importance of research and knowledge transfer as a potential driver of economic competitiveness in South Australia, and the key enablers of successfully embedding knowledge in the economy to create economic value.
2. Undertake a stocktake of current South Australian Government activities aimed at supporting or stimulating research, business innovation, and associated economic development including their cost, and any existing evidence of outcomes.
3. The nature and current performance of business-research institution collaboration in South Australia, benchmarked against that of other states.
4. Good practice models for government to enable, and make more productive, the process of turning research into economic competitiveness, including:
    a. options to deal with the barriers researchers face in engaging with businesses and other innovation users;
    b. ways of resolving the impediments to businesses engaging with research institutions around innovation in all of its forms; and
    c. cost effective state government support for the translation of research into economic competitiveness.

Inquiry process

The Commission will seek input from relevant experts (including from within the SA Government) and draw on prior work conducted in this field. In particular, the Commission will engage closely with the Department for Industry, Innovation and Science as the lead agency within the SA Government for science and innovation policy.

As a first stage the Commission will carefully review the evidence collected as part of its previous inquiries into Research and Development and into Health and Medical research to ensure that any work in this inquiry is not duplicative.

The Commission will consult with relevant public and private sector organisations in SA and other Australian jurisdictions, Universities and other research institutions active in SA, industry, professional associations and other key stakeholders.

The Commission is to publish a draft report containing recommendations for consultative purposes. A final report is to be provided to me no later than five months from the date of receipt by the Commission of these terms of reference.

Peter Malinauskas
PREMIER

13 / 12 / 2022

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