

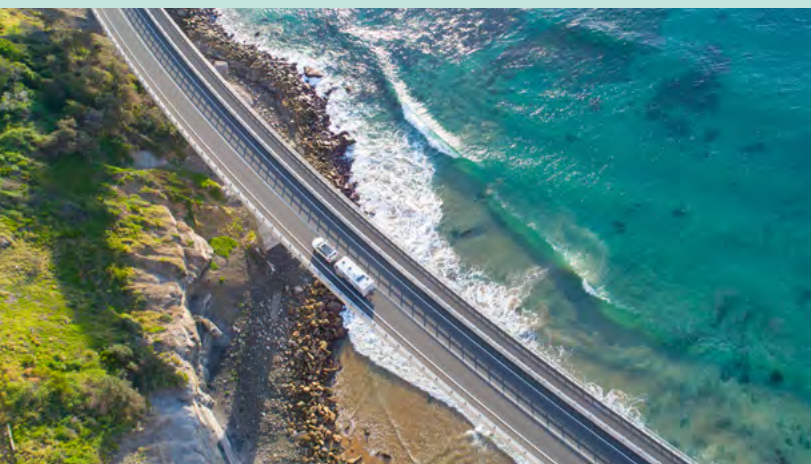


ENGINEERS
AUSTRALIA

Commercialisation of engineering innovation

EVP Directions paper
Technology & industry workstream

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Commercialisation of engineering innovation

EVP Directions paper for the technology and industry workstream

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Executive Summary

‘[Thomas] Edison’s genius was not in inventing; it was in inventing a system of invention...’

– Graham Moore, *The Last Days of Night*¹

Despite having one of the world’s most educated and wealthy populations, Australia remains a chronic underperformer² when it comes to the commercialisation of engineering innovation. Australia’s science, technology, engineering and maths (STEM) start-up ecosystem is consistently ranked as one of the worst in the developed world³. Historically, when genuine innovation has occurred, we have failed to commercialise domestically, which has resulted in jobs and opportunities going abroad. Wi-fi is a case in point: the technology was developed in Australia, but was predominantly commercialised abroad, taking the resulting jobs, companies and benefits of this breakthrough with it. This needs to change, because a vibrant STEM ecosystem is critical to engage with the array of challenges confronting Australia, from COVID-19 and climate change to declining wage growth and skills shortages.

To ensure the success of engineering-based industries in Australia, and to stay globally competitive, a strong reform agenda is required. In the 2022 Federal Budget there was bipartisan recognition of the importance of STEM innovation, but it lacked a specific vision and meaningful reforms. While funding levels are encouraging, high levels of spending are not a substitute for a long-term plan. They also risk excessive expenditure for minimal gain when it comes to invigorating the STEM ecosystem in Australia. One of the critical components of any start-up ecosystem is some measure of self-sufficiency. Any start-up that relies on government funding for its long-term existence is not strictly a commercial start-up and will struggle to be a source of jobs and growth if it does not find financial independence. Unlike other start-ups, those with a STEM orientation have additional challenges due to their highly technical nature.

The commercialisation of engineering innovation is frequently viewed through the lens of profit-making or job creation. However, the COVID-19 pandemic has illustrated how important STEM ecosystems are for crisis response, from creating vaccines to helping people and businesses transition to new modes of operating during lockdowns. The global pandemic has highlighted the structural challenges that Australia faces. It has been particularly evident during the COVID-19 pandemic that countries that have been able to quickly test, adapt, approve and roll out vaccines have been able to recover faster⁴.

For Australia to improve its capacity to commercialise STEM innovation, there are three core issues where a genuine policy shift is required:

- 01.** Improving models of collaboration and ecosystem development (Section 2)
- 02.** Reforming grants processes and tendering for government contracts (Section 3)
- 03.** Reducing regulation and incentivising investment in STEM start-ups in line with global best practice (Section 4).

1 G Moore, *The Last Days of Night*, Random House, New York, 2016.

2 See Section 2.

3 See Table 1.

4 National Academy of Engineering, *Engineering for Pandemics: Preparedness, Response, and Recovery: Proceedings of a Forum*, The National Academies Press, Washington, DC, 2021, doi:10.17226/26093.

Throughout this directions paper, a critical guiding principal has been to examine what is working abroad and applying it to the Australian context. Given the success of start-up and STEM ecosystems in the countries reviewed, there is a strong proof-of-concept, lending credibility to a speedier roll-out domestically. Consequently, many of the recommendations that have been suggested as solutions are already in place in the US or UK. Contextualising these approaches for the Australian market will be critical to the success of any reform agenda.

One of the opportunities in the Australian start-up scene is the appetite for increased involvement from STEM-related organisations. Making the three areas mentioned above a core policy focus for government, together with practical involvement from Engineers Australia (see Section 5), will help create a meaningful impact.



1. The global start-up landscape

STEM entrepreneurs in Australia face one of the most challenging start-up ecosystems in the developed world. While there are several global rankings, Australia has historically struggled to make the list in many of them. It was only in 2020 that international consultancy Startup Genome⁵ featured more than one Australian city in its top 40 global ranking. Sydney had typically been mentioned, but Melbourne had been absent for a number of years. No other Australian cities ever made the list. Table 1 illustrates the extent of Australia's underperforming start-up ecosystem. It also highlights where the issues are, and which high-performing ecosystems Australia should be seeking to imitate.

In Startup Genome's ranking, Sydney's start-up ecosystem is 27th, and Australia's next-highest-ranked start-up ecosystem is Melbourne at 36th. Position 36 is the lowest rank on the list⁶, which means no other Australian city is mentioned. Even though Sydney was Australia's highest-ranked city for start-up ecosystems, one of the study's key findings was that Sydney stood out due to its 'low quality of funding'⁷ along with few 'local, experienced VCs'⁸ when compared to other top ecosystems⁹. Sydney scored 1 out of 10 (the lowest score) when it came to venture capital (VC) investors based on years of experience and successful exits.

Table 1 – Global start-up ecosystems rankings¹⁰

Performance Category	Ecosystem	Global Ranking	Performance	Access to Funding	Market Reach	Connectedness	Talent	Knowledge
Top Performers	Silicon Valley	1	10	10	10	8	10	10
	London	2 (tie)	9	10	10	10	10	7
	New York	2 (tie)	10	10	9	10	10	5
Upper-Mid Tier	Tel Aviv	6	9	9	10	8	9	4
	Stockholm	10	8	5	8	5	7	4
	Singapore	17	4	8	8	7	4	1
Lower Performers	Sydney	27	3	3	1	8	5	1
	Sao Paulo	30	6	1	2	4	1	1
	Melbourne	36	1	1	4	6	1	1

5 Startup Genome is a global consultancy and policy firm specialising in developing start-up ecosystems around the world. They advise governments, in particular, on how to foster innovation hubs. For more information please see: <https://startupgenome.com/>

6 Startup Genome, Rankings 2020: Top 30 + Runners-up, Startup Genome website, 2020, available at <https://startupgenome.com/article/rankings-top-40>, accessed 16th September 2021.

7 Startup Genome, Rankings 2020.

8 Venture capital is seed to early-stage funding for start-ups. This capital can come from specialised VC companies, angel investors, government or larger corporations seeking to innovate. Getting venture capital funding is usually one of the greatest barriers start-ups face.

9 Startup Genome, Rankings 2020.

10 Startup Genome, Rankings 2020.

The metrics used above are outlined briefly below for context¹¹:

- **Performance:** indicates the estimated value of start-ups and their exits by both volume and growth. It also measures the speed of a start-up's growth, as measured by time between different funding series.
- **Access to funding:** measures the number of total start-up funding deals in the early stage, as well as the amount of funds available for investment. Also incorporates the number of investors and their experience, as measured by average exits and years of experience.
- **Market research:** indicates the ability of early start-ups to access customers, scale, and expand their reach.
- **Connectedness:** measures the extent to which different actors in an ecosystem are connected to each other. For a list of key actors in a STEM start-up ecosystem, see Figure 1.
- **Talent:** outlines the ecosystem's access to talent across the spectrum of STEM-related professions. It incorporates the experience of those working in the STEM space as a critical factor of that success and as a measure of quality. Part of this metric includes measuring those who have worked in start-ups before.
- **Knowledge:** includes patents and research elements, ranging from sheer volume of patents to their complexity. For STEM-related start-ups, this is a particularly critical element in their ability to commercialise innovation.

Across these key indicators, Australia consistently fails to perform. While aiming to be as competitive as start-up ecosystems in New York or London may be unrealistic due to the scale differential, Australia's proximity to Asia and our capacity to leverage this connectedness should give Australian start-ups access to some of the largest markets globally. Further, there is no reason why Australia should not be performing in line with or better than countries such as Israel or Singapore. Indeed, these countries are at a disadvantage because of their small market sizes in comparison to Australia – but they still outperform us.

During the implementation of the Turnbull government's 'innovation agenda' from 2015 to 2018, Sydney's start-up ecosystem ranking fell 10 places, and no other cities in Australia made the list. Given the number of government programs, organisations such as CSIRO, and budget dedicated to STEM innovation and start-ups, Australia should be doing better. At present, there is a clear disconnect between state and federal government rhetoric and outcomes for STEM start-ups.

11 For more information on the methodology Startup Genome used please see: Startup Genome, Methodology, Definitions & References, Startup Genome website, 2020, available at <https://startupgenome.com/article/methodology>, accessed 16th September 2021.

1.1 Start-up ecosystems as a function of regulation & tax

Many of Australia's best start-ups domicile abroad to get access to superior ecosystems. The two greatest Australian start-up success stories as measured by market capitalisation¹² are software developer Atlassian and graphic design tool Canva. Both are examples of companies that moved abroad to chase talent and more innovation-friendly tax and regulation systems. That both have domiciled in the United States or the United Kingdom helps to demonstrate why Australia should seek to imitate relevant elements of these two countries.

Despite being founded in Perth, Canva's parent company is based in the US state of Delaware, where the company tax rate is 8.7% rather than the 30% here in Australia. All the venture capital funding it raises is then lent to the subsidiary company¹³. While the headquarters of the company is in Sydney, the legal structure of Canva indicates that Australia's tax structure is uncompetitive. Atlassian is similar, albeit domiciled in London¹⁴. Despite both Atlassian and Canva having the majority of their operations and personnel in Australia, for tax purposes they are domiciled overseas. Until Australia has a sufficiently competitive tax structure for start-ups, we will continue to lose them abroad. This is even more true when there is little real advantage for start-ups to stay in Australia, given our poor performance in other key ecosystem areas. The real question is not simply how to stop companies restructuring to reduce tax, but how to ensure that the next generation of STEM start-ups is given the greatest opportunity to scale and commercialise innovation.

Far from losing start-ups abroad, Australia should be seeking to attract start-ups and founders from around the world, particularly Asia. The transparency of our legal system, due process and rule of law should make us a destination of choice for fledgling start-ups from countries that lack those benefits. This would have the dual effect of powering our domestic start-up ecosystem and providing a wealth of new organisations as a source of jobs and innovation.

If state and federal governments are genuinely committed to Australia having a thriving STEM ecosystem that is globally competitive, they need a reform agenda. At a minimum, this is required to keep us in line with other start-up ecosystems abroad and not actively discourage the commercialisation of STEM innovation through outdated regulatory and tax frameworks. Rather than attempting to reinvent solutions, there is a strong case for looking at how we can imitate the success of other highly ranked start-up ecosystems, in particular the US and UK, to implement proven ideas. Ideally, however, Australia should seek to leapfrog both these ecosystems to attract start-ups from around the world, particularly from Asia, which is already set to be the powerhouse of economic growth, innovation and job creation in the twenty-first century.

12 Market capitalisation is the market value of publicly listed companies.

13 M Bailey, 'Unicorn Canva reports maiden profit in second half of 2017', *Australian Financial Review*, 3 October 2018, available at <https://www.afr.com/work-and-careers/careers/unicorn-canva-reports-maiden-profit-in-second-half-of-2017-20181003-h165qq>, accessed 16th September 2021.

14 J McDuling, 'Atlassian is on the brink of joining the \$US10 billion club', *Sydney Morning Herald*, 20 October 2017, available at <https://www.smh.com.au/business/atlassian-is-on-the-brink-of-joining-the-us10-billion-club-20171020-gz4q7d.html>, accessed 16th September 2021.

2. Models of cooperation

There are several examples of state governments bringing people and organisations together to create start-up ecosystems. However, there remains a considerable dissonance between government rhetoric and what transpires on the ground.

While progress has been made in creating start-up and STEM ecosystems, given our starting point there is much catching up to do. If Australia is to take full advantage of the wealth and innovation benefits that come from a vibrant start-up ecosystem, it will be critical to find ways to accelerate this ecosystem development to become more competitive internationally.

Three cases have been used here to illustrate different models of collaboration in the development of innovation ecosystems. While there are several examples throughout Australia that could be used, the three below provide a useful contrast for insight into different models of cooperation. The UK example has been selected because of its STEM specialisation, which the Australian Government is currently attempting to emulate. While imitating too closely does have inherent issues, there is a strong case to be made for adapting what already works abroad. For Australia, a critical area will be exploring how to leverage our proximity to Indonesia, China and India as a way to overcome our relatively small market size.

2.1 Western Parkland City and Aerotropolis (New South Wales)

The Aerotropolis precinct in the new suburb of Bradfield, New South Wales, is a good example of collaboration between innovative companies, the NSW Government, and universities. The focus, as shown in Table 2¹⁵, is a blueprint for areas of cooperation with a focus on building domestic industries centred around high-growth areas. In a number of areas, like defence, the government has looked to engage with larger transnational corporations (TNCs), such as Lockheed Martin and Boeing, as a means to power innovation. However, while Australia is really only beginning to recognise the value of these innovation hubs, the US and UK have had this kind of engagement for over a decade. Looking at what is taking place in the US, the UK and Japan illustrates both the extent and level of sophistication for collaborating when it comes to engineering innovation. In the US particularly, the capacity to collaborate was one of the key elements in the country's ability to rapidly innovate, find solutions, test and mass-manufacture COVID-19 vaccines¹⁶.

15 Based on: NSW Government Western City & Aerotropolis Authority, Delivering The Western Parkland City, Western Parkland City Authority website, 2019, available at https://wpca.sydney/assets/Documents/Publications/Delivering+the+Western+Parkland+City_December+2019.pdf, p19, accessed 16th September 2021

16 National Academy of Engineering, *Engineering for Pandemics*.

Table 2 – Focus areas for Bradfield Aerotropolis

Advanced Manufacturing, Aerospace & Defence	Agribusiness, Pharma, Freight & Logistics	Health & Education
Quantum sensing	Food manufacturing	Health research and development (R&D)
Quantum location	Logistics	Med-tech
Space/satellite construction	Food producers	Universities
Autonomous vehicles	Freight and supply chain technology	Vocational education
Artificial intelligence		School engagement
Robotics		Public/private health
Materials management		Pharma manufacturing

Industry experts who have worked on both the UK’s Advanced Manufacturing Research Centre (AMRC) and the Western Parkland City have reported surprise at how little is going on in Australia regarding advanced manufacturing. Part of the Aerotropolis will house an Australian Advanced Manufacturing Research Centre, conceptually based on the AMRC in the UK. This attempt to mimic what has been successful in the UK is encouraging. The UK’s AMRC has been operating since 2007 and has a partnership with Sheffield University and Rolls-Royce. Drawing on this experience gives Australia an opportunity to quickly bridge the capability gap between the two countries.

Of concern is a perceived mindset within Australian state and federal government agencies that sees STEM start-ups marginalised, which is in sharp contrast to the UK’s AMRC. Australian government agencies are less focused on engaging with start-ups than they are with well-established companies, often those with a global footprint, such as aviation stalwarts Lockheed Martin and Boeing. In the context of the commercialisation of innovation, excluding STEM start-ups ignores the source of some of the country’s most important innovative firms.

Partnerships with international conglomerates domiciled overseas is useful, but the benefits will be marginal if the aim is to support the commercialisation of Australian innovation to create jobs domestically. Indeed, it may even be counterproductive, as the financial capital, talent and national focus is on TNCs rather than on developing innovative firms domestically. Not only does this illustrate the mindset of those engaged in the WCP, but it exposes a perennial problem in the Australian context: STEM start-ups are treated as an afterthought rather than being put front and centre. If the NSW Government is seeking to develop an innovation-driven economy and an advanced domestic manufacturing base, it needs to include home-grown Australian companies. This means creating open, inclusive and diverse ecosystems to maximise the return on investment in the Bradfield Aerotropolis.

Table 2 outlines the target areas for Western Parkland City and Aerotropolis. This is well-focused on high-growth areas at the forefront of engineering. However, there is a risk of failing to translate innovation into commercially viable companies that create jobs and opportunities for Australians. Given the high level of engagement with TNCs, government will have to justify spending taxpayer money to fund innovation in partnership with overseas firms that compete with domestic small-to-medium enterprises (SMEs). In contrast, supporting Australian firms that reinvest their profits here has a positive multiplier effect.

While the precinct is in Sydney, this case highlights several fundamental issues in relation to the Australian STEM start-up scene and those state and territory governments seeking to pursue an ‘innovation agenda’. The National Manufacturing Priorities Roadmap is another case that drew members from industry. Once again, Australian innovators and manufacturers were in the minority for each of the six Taskforces. Large corporations domiciled abroad were well-represented, as were government departments and organisations such as CSIRO. STEM innovation that excludes start-ups is unfortunately a common theme. It is impossible to talk meaningfully about domestic manufacturing without significant representation from domestic manufacturers, SMEs or Australian start-ups.

2.2 Lot Fourteen (South Australia)

In contrast to NSW's Western Parkland City and Aerotropolis, Lot Fourteen in South Australia stands out because of its focus on collaboration and creating a genuine ecosystem with STEM start-ups playing a central role. Lot Fourteen is a state government attempt to create a hub for start-ups to innovate, commercialise and grow. There are several sizeable facilities, with some parallels to the Aerotropolis in terms of the scope, but the project puts start-ups at the centre. There is a specific focus on commercialisation and bringing together academia, government and venture capital to support new, innovative businesses. At the time of writing, Lot Fourteen is promising; however, the vision has yet to be fully realised, with many of the precincts existing on paper only.

It is encouraging that there has been buy-in from government, with the former Premier of South Australia, Steven Marshall, driving Lot Fourteen from the political side. One of his stand-out comments concerning the precinct was his emphasis on supporting 'businesses at all stages – from start-ups to scale-ups'¹⁷, with a particular emphasis on entrepreneurship and 'venture capital services'¹⁸. Whereas the Aerotropolis is built around innovation and larger corporations, Lot Fourteen's ecosystem recognises the critical link between innovation and commercialisation, and seeks to be the bridge between the two. They have specifically earmarked significant areas to develop as co-working¹⁹ spaces, comprising 650 desks, for those in start-ups. They have brought in start-up hubs like Stone & Chalk²⁰, as well as reaching out to key partners in the venture capital space. The SA Government is also including marginalised and at-risk groups who are underrepresented in the start-up space. An example is The Circle – First Nations Entrepreneur Hub²¹, which provides business support, mentoring and networking to support Indigenous Australians who have founded innovative businesses.

Lot Fourteen has four focus areas²², many of which overlap with those of the Bradfield Aerotropolis. It will be telling to see which project proves most effective. As a model of developing STEM ecosystems in Australia, SA may provide a blueprint that can be readily replicated across major cities. The ongoing challenge for the SA Government will be whether it can continue to execute this vision and if its efforts are realised in the founding of commercially viable start-ups that are able to scale. Additionally, while extensive involvement by the SA Government is necessary to generate the initial momentum for Lot Fourteen, it is critical that the long-term ambition is for this effort to be largely self-sustaining. While there will always be an important role for government to play, a commercially viable start-up ecosystem that is globally competitive requires the market, rather than the government, to pick winners.

17 Department of the Premier and Cabinet, Lot Fourteen Department of the Premier and Cabinet, Government of South Australia, 2021, p2, available at <https://lot-fourteen.s3-ap-southeast-2.amazonaws.com/files/corporate-brochure/Lot-Fourteen-Corporate-Brochure-May-2021.pdf>, accessed 16th September 2021.

18 Department of Premier and Cabinet, *Lot Fourteen*, p2.

19 A co-working space in this context is essentially office space designed for increasing collaboration between start-ups to foster growth.

20 A co-working space in Sydney, NSW.

21 Government of South Australia, The Circle – First Nations Entrepreneur Hub, 2021, available at <https://www.thecircle.sa.gov.au>, accessed 16th September 2021.

22 Space, defence, high-tech and creative industries.

2.3 Advanced Manufacturing Research Centre (United Kingdom)

Founded in 2003, the Advanced Manufacturing Research Centre (AMRC) is a world-leading STEM ecosystem with over 125 partners. It has centres throughout the UK and is actively engaged with a wide spectrum of engineering-based industries, from global defence industry giants such as BAE Systems, through to biomedical research and development (R&D) firms and fledgling start-ups. AMRC continues to be a centre of innovation and a source of jobs, economic growth and advancing the science and practice of engineering.

Encouragingly, the Western Sydney Aerotropolis has partnered with the UK's AMRC. Given the success and longevity of the AMRC, there is value in plugging into this already-vibrant STEM ecosystem and using it to develop something similar in Australia. In many respects, the UK's AMRC provides a template for the future development of the Aerotropolis, Lot Fourteen and other developing innovation centres. While the UK Government has been investing in this ecosystem since 2007, there is scope for its model to be applied in the Australian context to accelerate development.

The capabilities that the AMRC is focused on are significantly narrower than those of the Aerotropolis or Lot Fourteen. The depth of expertise that has developed because of this specialisation may well be a lesson. Australian innovation centres are at risk of attempting to invest in too wide a range of sectors, and thus failing to reach sufficient depth of expertise. Recognising how far behind Australia is in STEM start-ups and advanced manufacturing may risk an overcorrection where we do not pick our niche. High levels of government involvement may also distort the start-up space in STEM fields as governments attempt to pick winners by choosing whom they fund, rather than allowing market forces to determine what works and what does not.

In the early stages of development, where Australia finds itself, creating a globally competitive start-up and STEM ecosystem requires high levels of government involvement. However, any long-term vision of a vibrant STEM start-up sector requires an organic and self-funding model. While there will always be a role for government in these ecosystems, systemic reliance on government will ultimately be unsustainable.

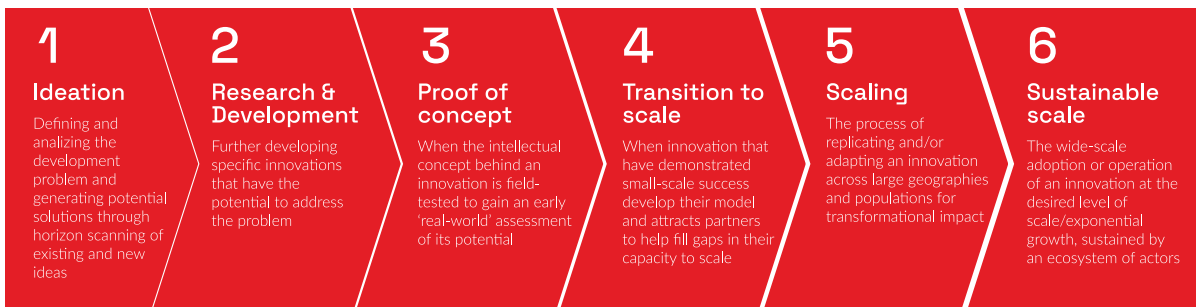
2.4 Practical recommendations for improving collaboration

Collaboration is the cornerstone of developing STEM and start-up ecosystems. Providing ease of access for large conglomerates, start-ups and VCs alongside academia and government will be fundamental in determining the quality of Australian innovation. It will also be critical when standing up to global competition. Figure 1²³ outlines the number and variety of participants involved in a successful innovation ecosystem. Given the relative infancy of the Australian ecosystem, government has a larger role to play, particularly in enticing other critical actors to participate. Where domestic deficiencies exist, for example a lack of seed-focused STEM VCs, government provides a means for these firms to develop.

Figure 1



Scaling stages



23 International Development Innovation Alliance, Typical Actors in an Innovation Ecosystem, IDIA website, n.d., available at <https://www.idiainnovation.org/ecosystem-actors>, accessed 16th September 2021.

To promote collaboration, Engineers Australia has the following recommendations:

01. Start-up ecosystems, such as Lot Fourteen, in collaboration with government, should continue to explore and develop partnerships with vibrant STEM ecosystems in the UK, US and other world-leading countries. They should do this with the purpose of learning from best practice, cooperating on STEM innovation, and promoting Australian start-ups abroad commercially. Given the prevalence of venture capital funding in the US and UK, these international partnerships should be leveraged to give Australian start-ups access to funding from overseas when it is not available domestically. Tax and other incentives (see Section 4) should be explored to encourage this practice.
02. Focus on putting start-ups at the centre of STEM innovation hubs, rather than focusing on larger conglomerates domiciled abroad. This includes actively seeking input from start-ups, accelerator programs, incubators and other actors involved in the STEM innovation ecosystem. By putting start-ups, and SMEs more broadly, at the centre of innovation, the emphasis will naturally turn to commercialisation and scaling – with the associated benefits in terms of jobs, economic growth and creating opportunities for Australians.
03. Recognise the important role government plays, particularly in the early stages of developing a national STEM ecosystem, and encourage collaboration. This means providing grants not only for start-ups, but also for STEM-focused VCs, and grants to support industry collaboration to promote the holistic development of the ecosystem. Critical to this, however, is ensuring that the long-term plan is for minimal government involvement to ensure ecosystems are self-sustaining and are not a financial drain on government.
04. Recognising the limitations of the small Australian market, government should play a significant role in supporting start-ups to expand into the wider Asia-Pacific market. Given Austrade's networks in these countries, there would be opportunity to leverage these networks for Australian start-ups.

Implementing these recommendations will go a long way to increasing collaboration both within Australia and with the rest of the world, while keeping the commercial aspect of innovation at the centre of our national efforts. Given the importance of commercialising engineering innovation, government investment should support the needs of the private sector to take up the mantle when it comes to investment in STEM innovation.

3. Government grants & contracts

Federal government grants are an important way to encourage the development of innovative STEM start-ups and SMEs when there is a lack of available private sector funding.

Given the current lack of venture capital investment in start-ups, grants have a larger role to play in the Australian STEM start-up ecosystem than in other countries. Government contracts, public private partnerships and the tendering process should also be viewed as a means by which start-up development and home-grown innovation can be supported. The way government contracts are administered has, and continues to be, counterproductive and biased against start-ups and SMEs. As outlined below, there is ample opportunity to invigorate the Australian start-up scene, provided changes in process occur to encourage openness and a diversity of applicants.

3.1 Administrative weaknesses in the provision of government grants

There are numerous government grant programs, but interviews by Engineers Australia with start-ups and other industry participants indicate that systemic inefficiencies continue to inhibit their impact. Founders of STEM start-ups have repeatedly noted:

- challenges around finding appropriate grants and relevant programs
- the administrative burden and bureaucratic process of applying for grants
- the long wait time between applying, being accepted and receiving the funds.

There is also a significant disparity between large and small players, because larger firms can dedicate significant time and money to apply for grants, while smaller start-ups, which are arguably in more need of such funding, are unable to invest sufficient human capital to apply.

This is not a new problem, and it fundamentally undermines the purpose of a grants program. While processes to ensure funds are used appropriately are important, government needs to ensure the compliance burden is not counterproductive and is instead streamlined and centralised. When there are eligible and innovative businesses looking to commercialise technology developed in Australia, government support should be easily accessible. Further, given that start-ups are highly time-sensitive in nature due to their limited capital and liquidity limitations, funds should be transferred quickly to have a meaningful impact. Waiting six months for funding after a successful application can mean the difference between survival or dissolution for a start-up.

Grants programs should be easy to use for applicants, have minimal administrative processes, and take a risk-based approach to probity checks. This should be part of a larger, integrated framework to create systems that promote innovation and ensure compliance is not a burden on start-ups.

3.2 Recommendations for improving the administration of government grants

Encouraging the organic development of an Australian start-up ecosystem with deep competency in STEM requires government to rethink how grants are administered. Our poor global rankings as outlined in Section 1 should act as a strong, objective indicator for the effectiveness of government policy to date. They clearly show a need for change.

In consultation with Engineers Australia members, start-ups and industry, we have identified three reform principals that are missing from the grant process:

01. **Accessibility** – provide a centralised repository of grants and programs for ease of access
02. **Ease of application** – simplify and streamline the application process for time-poor start-ups and transfer the burden of applying to government as much as possible, to alleviate resource requirements
03. **Time sensitivity** – reduce the time between a successful grant application and funds being transferred to start-ups.

To facilitate the above points, having hard time limits would ensure certainty. This would include, for example, a 30-day maximum deadline for government to assess applications, and 30 days from successful assessment to payment of funds. This would ensure a lift in the quality and effectiveness of grants.

Implementing systems and application processes for grants around these three principals will be crucial in supporting STEM start-ups and in closing the gap between government rhetoric and outcomes.

3.3 Government contracts as a means to fund innovation

Government tendering for contracts and partnerships with the private sector should prioritise innovative STEM SMEs to support the Australian start-up ecosystem. The federal and state government's big-spending agenda to combat recessionary tendencies brought about by the global pandemic is a unique opportunity to invest in the long-term growth and sustainability of Australian start-ups. From infrastructure and defence, through to advanced manufacturing and biotechnology, there are critical areas where the government can invest in domestic firms. This also provides an opportunity for STEM start-ups and SMEs, which otherwise would not see funding or be able to scale off the back of substantial government spending.

Many parts of applying for government contracts and tendering have a very high administrative burden for applicants. On this basis alone, many innovative Australian start-ups and SMEs are cut out of the process in favour of larger transnational corporations, which have entire departments dedicated to the application and tendering process. Their size and existing revenue, as well as extensive networks, mean there is a power imbalance that does not necessarily reflect the quality of the work or service.

This imbalance is particularly evident when looking at the defence industry. It is encouraging to see mandatory clauses requiring a certain percentage of products to be manufactured in Australia. However, there are persistent ethical and transparency issues around the true extent of these larger corporations' domestic manufacturing and employment capabilities. An example is French multinational Naval Group's development of Australia's next-generation submarines. The agreement with the federal government stated that Naval Group would

manufacture 90% domestically. However, this was subsequently reduced to 60% and, at the time of writing, questions were being raised publicly about whether even 50%²⁴ will be achieved²⁵. A similar story can be told when it comes to the building of Australian frigates. The situation has now become so problematic that an audit²⁶ of (mostly foreign) defence companies is underway to determine if local defence SMEs are being actively shut out of the defence industry. Part of the issue is also that many domestic firms are unable to comply with the technical and functional requirements, alongside minimum insurance and commercial capabilities. This indicates the need for a holistic reframing of how government contracts go to tender to support STEM innovation. This should be applied not only to the defence industry but across the board, to ensure that smaller, innovative companies are given the opportunity to compete, and that contracts are won or lost on merit.

3.4 A framework to reform government tendering processes in Australia

The three principles for improving the administration of government grants (Section 3.2) are similarly applicable when it comes to government tenders. Where the administrative burden of applications cannot be reduced or streamlined, it should be shifted to government to open up the process to start-ups with proven capacity, and to STEM SMEs. Increasing the total number of initial applications may reduce costs for government by promoting competition and creating a level playing field for fledgling Australian businesses. The three key reform recommendations are:

- 01.** Adapt the UK's managed shared audit (MSA) by requiring larger corporations that have won government contracts to fully partner with smaller, domestic start-ups so that the start-ups can increase their capability and grow.
- 02.** Make dual-awarding contracts a more standardised practice to support local firms that are incapable of fully delivering on a contract due to issues of scale. The vision of dual-awarding contracts is to promote the development of domestic competencies and power Australian businesses to scale and compete with larger, foreign corporations.
- 03.** Implement a secondary stream in tendering for government contracts specifically for start-ups with innovative ideas to test and iterate their products. This would also allow them to leverage the revenue and networking from these contracts to develop their organisation further.

These three points are designed to support innovation, empower Australian businesses, and open up government contracts.

24 A Tillett, 'Friction over new subs raises prospect of 'son of Collins'', Australian Financial Review, 14 February 2020, available at <https://www.afr.com/politics/federal/friction-over-new-sub-s-raises-prospect-of-son-of-collins-20200213-p540g8>, accessed 16th September 2021.

25 A Tillett, 'First 90pc, then 60pc, French still won't commit to local sub parts', Australian Financial Review, 10 August 2020, available at <https://www.afr.com/politics/federal/first-90pc-then-60pc-french-still-won-t-commit-to-local-sub-parts-20200809-p55jyo>, accessed 16th September 2021.

26 A Tillett, 'Defence companies to be audited over promises of local jobs', Australian Financial Review, 6 February 2020, available at <https://www.afr.com/politics/federal/defence-companies-to-be-audited-over-promises-of-local-jobs-20200205-p53xvl>, accessed 16th September 2021.

3.4.1 Managed shared audit (MSA)

The Australian Government should consider adapting the MSA that is currently being rolled out in the UK. The MSA is the UK's response to market dominance by the Big Four accounting firms by requiring partnerships with smaller firms that can then leverage the skills, experience and revenue generated by working on these contracts. By dual-awarding contracts, the UK Government can increase the competency of smaller firms, empower them to take on larger contracts independently in the future, and make the sector more competitive. The Big Four accounting firms are predicted to lose market share and their dominance in the UK as increased competition and transparency force a more merit-based marketplace²⁷. In Australia, there are calls for a similar process to be undertaken²⁸.

3.4.2 Dual-awarding contracts

While the MSA specifically targets auditing, it could also be applied to other industries to promote innovation and start-ups in Australia. Government should dual-award contracts with start-ups that have relevant touch-points and whose innovation promises genuinely added value. Depending on the size of the contract, there may be scope to include multiple STEM start-ups, and having access to additional resources and human capital would accelerate their development. In this way, government would be creating partnerships between innovative STEM start-ups and larger, often international, corporations. This would allow innovative Australian companies to leverage the skills and experience of these large firms into domestic jobs and business growth. Given the small size of many STEM start-up teams, partnerships with the conglomerates that win government contracts would provide these small start-ups with exposure and access to resources they wouldn't usually have. It would also afford them the opportunity to prove their concept and adapt where required.

3.4.3 Secondary application stream for government contracts

Given both the federal government's and opposition's commitments to developing an innovation-driven economy along with an advanced manufacturing sector, secondary application streams are a practical way for the government of the day to ensure it maximises the impact of COVID-19 recovery expenditure. Implementing the right model of start-up engagement may take a few iterations to get right. Once a government contract has successfully been awarded to a larger corporation, it should be a shared responsibility to reach out to start-up hubs, accelerators, and incubator programs to identify relevant start-ups to partner with. Alternatively, government could introduce a secondary application stream for selected government contracts, with the additional stream having limited compliance and regulation, specifically encouraging start-ups to apply. This secondary stream would have eligibility caps on annual turnover and number of employees to ensure applicants are start-ups or SMEs.

27 G Plimmer, 'PwC, Deloitte, KPMG, EY face UK break-up call amid Carillion demise', Australian Financial Review, 16 May 2018, available at <https://www.afr.com/companies/professional-services/pwc-deloitte-kpmg-ey-face-uk-breakup-call-amid-carillion-demise-20180516-h10455>, accessed 16th September 2021, and H van Leeuwen, 'UK regulators ramp up pressure on Deloitte, EY, KPMG and PwC with new probes', Australian Financial Review, 10 October 2018, available at <https://www.afr.com/companies/professional-services/uk-regulators-ramp-up-pressure-on-deloitte-ey-kpmg-and-pwc-with-new-probes-20181010-h16fho>, accessed 16th September 2021.

28 J Buckley, 'UK moves to break up big 4 audit dominance', Accountants Daily, 22 March 2021, available at <https://www.accountantsdaily.com.au/business/15477-uk-moves-to-break-up-big-4-audit-dominance>, accessed 16th September 2021.

Ultimately, grants and the awarding of government contracts should be used in tandem with reforms to encourage the private sector to invest in STEM start-ups. As outlined in the following section, this entails creating a system that does not rely on government involvement for innovation to occur or be commercialised. Anything short of an independent STEM start-up ecosystem is not sustainable over the long term, nor will it be competitive internationally. Grants and government contracts will have a role to play, but they should be viewed as a small part of a much larger ecosystem.



4. Tax and regulation

The regulatory and compliance burden for engineering start-ups is frequently higher than for start-ups in other sectors due to the regulated nature of the industry.

In contrast, pure technology firms often have little regulation, which enables them to scale rapidly and reduces the capital investment required. STEM start-ups that are at the nexus of innovative technology and traditional engineering practice are frequently mired in regulatory or legal uncertainty. Where clear laws and regulations do exist, they frequently serve only to increase costs, dissuade investors, and threaten the survival of the start-up. The challenge for many of these start-ups is the cost to engage engineers or other relevant professionals, alongside other compliance requirements.

Part of the reason behind Australia's poor Global Ecosystem Ranking, as shown in Table 1, is the result of our uncompetitive tax regime, which is unfit for STEM start-ups and innovation. Whereas the US and UK both pioneered innovative tax schemes to promote early-stage or seed investment in start-ups, Australia fell behind, and is increasingly known for tax rates that encourage domestic innovation to domicile abroad. Without sustained tax reform that specifically targets venture capital in STEM, government investment in the form of grants or awarding of contracts (Section 3) will yield little more than a short-term spike in activity. It is no longer an option for government to continue to support the status quo when it comes to taxes on venture capital and R&D if it is serious about supporting a STEM innovation ecosystem.

4.1 Special regulatory categories for start-ups

To promote innovation, government should investigate creating special regulatory categories for start-ups as defined by low revenue and staff numbers. Regulatory exemptions will empower start-up teams to focus on innovation and commercialisation rather than compliance. The capital cost reduction will have the combined effect of freeing up finance to invest in the development of the core product and giving breathing room to start-ups that initially struggle to attract investment.

Execution of this idea may vary depending on the industry, but actively engaging with start-ups associated with accelerator programs or start-up hubs that have some internal vetting processes is a good way to ensure quality start-ups are being supported to innovate. A similar case can be made for those STEM start-ups operating out of university innovation hubs, which may indicate a stronger idea and innovation values allied to highly capable and qualified people. A pilot program that grants wide-reaching regulatory exemptions could begin with these innovation centres. This would give the chance to both prove the validity and outcomes of these exemptions and investigate useful iterations to promote commercialisation outcomes. Potential regulatory exceptions could include:

- where relevant, reducing the business licensing, registration and compliance requirements for engineering and STEM companies more broadly, particularly where there is no safety concern associated with the regulation. This is especially relevant where the products are in their early and beta testing stages, which will inevitably require changes

- for chemical and biomedical engineers whose products require sign-off from the Therapeutic Goods Administration (TGA), having fast-track applications with minimal touch-points from the TGA
- where trademarks, intellectual property (IP) and copyright are concerned, providing rapid turnarounds and minimal costs to the start-up.

When it comes to regulation, government should support start-ups to be quick to get their products to market, rather than slowing them down due to long application and sign-off periods. If even a small fraction of these start-ups were to become successful companies, the financial benefit in long-term tax revenue would more than compensate government for the risks posed by providing exemptions from business regulations that are designed to regulate the operations of established companies and multinationals. Prioritising exemptions from regulations with a high cost of compliance would be a valuable first step. If these companies were to later scale up, the normal regulatory regime would then apply. This limited deregulation would benefit both early STEM start-ups and VCs who want to see their seed funding go to product development and client acquisition rather than regulatory compliance.

4.2 Tax reform

Tax reform will make or break the future of VC investment in STEM start-ups. Unlike other reforms suggested in this directions paper, tax has the capacity to radically change the rules of the game in a way that other levers of government simply will not be able to do. While government investment through grants (Section 3.2), regulatory exemptions (Section 4.1) and contract-sharing (Section 3.4) have an important role to play, tax reform has a much larger effect.

Australia has one of the lowest levels of VC investment among OECD countries (see Section 1, Table 1). Failure to change the tax treatment of VC investment in STEM start-ups will see Australia fall further behind. One of the most consistent messages from STEM start-ups, hubs and innovation centres is the infantile VC sector in Australia. One of the reasons this has remained the case for so long, while VCs in the US and UK have developed, is that our tax regime is not fit for purpose. It fails to support those looking to invest in innovation, punishes risk-takers, and does not reward those who are able to provide support for STEM start-ups. While implementing the tax regimes outlined in Section 4.4 may reduce government revenue, this should be viewed through the lens of an investment in the developing a serious innovation economy and improving productivity levels²⁹.

Rather than attempting to reinvent a tax system designed to support innovation, Engineers Australia recommends taking best practice from the UK in how it treats VC investment and applying this to the Australian context. This will hasten implementation and ensure the reforms are tried-and-tested ideas requiring minimal iteration.

29 HM Revenue & Customs, Venture Capital Schemes Manual, HM Revenue & Customs, Government of the United Kingdom, 2021, available at <https://www.gov.uk/hmrc-internal-manuals/venture-capital-schemes-manual/vcm30000>, accessed 16th September 2021.

4.3 SEIS & EIS – lessons from the UK

There are two primary tax incentives in the UK to encourage VCs to invest in STEM start-ups. The first is the Seed Enterprise Investment Scheme (SEIS), and the second is the Enterprise Investment Scheme (EIS). These schemes contrast with the closest comparison in Australia, which is the Research and Development Tax Incentive (R&D Incentive). Even this comparison is tenuous, as they essentially target different tax groups. The ideal scenario for tax reform in relation to VCs would be the implementation of an Australian equivalent of the SEIS and EIS alongside the R&D Incentive.

These three tax regimes can be summarised as follows:

- **SEIS³⁰ (UK):** This grants a tax credit worth 50% of the investment; gives exemptions on capital gains tax (CGT) on earnings from shares; and exempts profits realised within three years from CGT altogether if they are reinvested in an SEIS-qualifying start-up³¹. It targets new start-ups seeking capital investment.
- **EIS³² (UK):** This grants a tax credit worth 30% of the investment, defined as the amount paid for shares in the start-up. It targets existing start-ups to scale further and grow.
- **R&D Incentive (Aus):** This is a tax offset of up to 43.5% to support companies to invest specifically in R&D or supporting services. It targets existing companies to invest in R&D.

The R&D Incentive deliberately excludes the commercialisation aspect where R&D has generated meaningful outcomes. In contrast, both the SEIS and EIS encourage the use of investment funds to scale and commercialise innovative ideas. The R&D Incentive reflects the chronic issue in the Australian STEM ecosystem, where we are competent at conducting innovative R&D but fail to commercialise. This incentive clearly targets established firms rather than supporting innovation at the grassroots level.

One aspect where the R&D Incentive is effective is in requiring firms to self-assess their eligibility, reducing the burden of lengthy application processes. The concept of allowing firms to self-assess and push the administrative burden back onto government, in this case the Australian Taxation Office, is innovative. This model may have applications to any Australian version of the SEIS and EIS, and would ensure that any new VC-focused tax incentives do not become overly burdensome for start-ups or VCs. The first step for the Treasury is to conduct a cost-benefit analysis to analyse real costs and project the benefits of this kind of reform.

30 HM Revenue & Customs, *Venture Capital Schemes Manual*.

31 HM Revenue & Customs, *Investment Schemes*, HM Revenue & Customs, Government of the United Kingdom, 2018, available at <https://www.gov.uk/guidance/venture-capital-schemes-apply-to-use-the-seed-enterprise-investment-scheme>, 16th September 2021.

32 HM Revenue & Customs, *Investment Schemes*.

4.4 Ongoing regulatory and tax reforms

The Australian Government can no longer simply view our STEM ecosystem in national terms – it must recognise that talent and start-ups are highly mobile and are going abroad because we are not internationally competitive. To ensure Australia becomes a world-leading destination for start-ups and talent in the OECD, an ongoing reform agenda is required.

In the short term, significant changes are required, like the introduction of regulatory exemptions and tax reforms to bring Australia into line with other major start-up ecosystems. Even if Australia were to improve our global ranking when it comes to start-ups, a reform agenda needs to be maintained to ensure our ongoing competitiveness on the world stage.

That the UK Government has a dedicated Venture Capital Reliefs Team (VCRT)³³ in HM Treasury is indicative of the seriousness with which VCs are treated and the UK government's focus on developing its STEM innovation ecosystem. At a minimum, establishing similar subgroups within the federal and state/territory treasuries will promote organic investment in start-ups. Likewise, this will provide more investor certainty, troubleshoot any issues, and assist in the application of reforms.

Building on this concept, there is an opportunity to establish a start-up or innovation ecosystem subgroup within the federal government with the sole purpose of looking at reforms to improve Australia's competitiveness. The VCRT would fall under this subgroup, and it would also have room for additional teams looking to develop Australia's STEM and innovation ecosystem with a specific focus on commercialisation.

If government intends to follow through with its agenda of becoming a centre of global innovation, Industry 4.0 and STEM, reform is required. Government funding in the context of a poor regulatory and tax framework may well be wasted, and is no replacement for fit-for-purpose regulation.

33 HM Revenue & Customs, *Venture Capital Schemes Manual*.

5. Concluding remarks

'Lean into the future when the world changes around you'

– Jeff Bezos, founder of Amazon and Blue Origin

Australia risks falling further behind other OECD countries when it comes to the future of the engineering profession and the wave of jobs, innovation and economic growth that it will engender. Reforms are required to reinvigorate the STEM ecosystem and encourage the commercialisation of innovation. As part of Engineers Australia's commitment to the profession and the wider community, we have a critical role as a voice for reform to support the development of STEM in Australia. There is both the need for a strong policy framework, as outlined in this directions paper, and practical actions Engineers Australia can take to support local STEM start-ups.

The fact that our country remains at the bottom of OECD rankings is an indictment on prior and existing government policy and implementation. It points to the desperate need for industry leaders to promote proven reforms in this space. For Engineers Australia, leveraging our wide network of members and engaging with key decision makers will be critical to building momentum around a reform agenda. The rhetoric from politicians across the political spectrum is encouraging and shows there are many natural allies already pushing a similar set of reforms. This directions paper contributes to the existing conversation around how we support STEM and an economy that creates jobs, companies and growth through innovation – and indeed productivity improvements in the economy more broadly.

Staying on the cutting edge of the engineering profession and shaping its future development requires us to engage proactively with the wider start-up and STEM ecosystem. It has been encouraging that there is a high level of interest to drive reforms in this area. Discussions with internal stakeholders, engineering start-ups, venture capital firms and innovation hubs have all viewed Engineers Australia's increasing involvement as a significant plus.

For Australia to 'lean into the future' means allowing strategic risk-taking. It is hoped the reforms suggested in this directions paper clear the way for innovators to do just that and advance the engineering profession.

6. Summary

What's the challenge?

Australia continues to fall behind the rest of the developed world when it comes to the performance of STEM start-ups and the commercialisation of engineering innovation. Chronic issues include access to funding from experienced venture capitalists, access to STEM talent, growth, the long-term outcomes of start-ups founded domestically, uncompetitive regulation, tax frameworks disincentivising investment in start-ups, and the retention of STEM start-ups and engineering innovation in Australia.

What's the opportunity?

This directions paper has examined how successes from high-ranking STEM start-up ecosystems abroad, especially the US and UK, could be applied in the Australian context to promote the commercialisation of engineering innovation domestically. This directions paper focuses on several themes, outlined below, which would make Australia's start-up ecosystem more competitive.

Section 2: Models of cooperation

Section 2 contrasts efforts by the NSW and SA governments to create advanced manufacturing and innovation centres and how they treat start-ups. This directions paper favours a collaborative approach that encourages corporate engagement, leverages international partnerships, promotes a financially sustainable ecosystem, and puts start-ups as the centre of these innovation hubs.

Section 3: Government grants and contracts

This section recommends adapting the UK's managed shared audit system, requiring corporations that have successfully bid for government contracts to partner with smaller, domestic firms to increase their capability and grow. It also examines ways to reform government grants and contracts to make them more accessible to start-ups.

Section 4: Tax and regulation

Section 4 examines the compliance and regulatory burdens on STEM start-ups. It recommends streamlining these, particularly in relation to licensing, registering intellectual property, and sign-off from the Therapeutic Goods Administration. It also explores ways to reform the tax system to benefit start-ups.

Table 3 – Summary of recommendations

Opportunity	Policy Action	Current Policy Status Action	EA Action
Section 2: Models of cooperation			
Create Australian start-up hubs renowned for collaboration	Make the Bradfield (NSW) precinct a more inclusive space for start-ups. Provide incentives for corporations, universities, VCs and Australian start-ups to collaborate.	Governments need to have a long-term vision and ensure current projects are thoughtfully executed. Australia's post-COVID recovery should incorporate start-ups as a vehicle for jobs and economic growth.	EA has a pivotal role to play by participating in STEM start-up ecosystems. For full recommendations, see Section 5.
Connect Australian start-ups to Asia-Pacific markets and make Australia a start-up staging ground for expansion into Asia.	Austrade should facilitate Australian start-ups to expand abroad. Australian start-up hubs need to develop strong partnerships with similar organisations/VCs in the Asia-Pacific, particularly China, India and Indonesia.	Austrade already has many of the capabilities and networks that start-ups could use, but tends to have a focus on larger organisations. A specific stream to foster international collaboration for start-ups/VCs would be highly beneficial.	Leverage EA's international networks and connections with partner organisations abroad to facilitate connectivity and collaboration.
Section 3: Government grants and contracts			
Government grants that work for start-ups	30-day maximum deadline to assess applications and 30 days from successful assessment to receipt of funds.	Limited-to-no deadlines are currently given. Those that do exist are excessively long.	Build the case for change by engaging with government and like-minded organisations.
Government contracts that empower Australian innovators	Adapt the UK's managed shared audit system by implementing a secondary stream for awarding contracts specifically targeting Australian start-ups.	Attempts to enforce local content requirements are highly ineffective in many sectors, which reduces the opportunity for domestic SMEs and start-ups.	Build the case for change by engaging with government and like-minded organisations.
Section 4: Tax and regulation			
Competitive tax regime to attract STEM start-ups from abroad and retain those started domestically	Implement an SEIS and EIS (tax reforms) and explore additional tax incentives.	Australia's tax regime is currently uncompetitive compared with leading start-up ecosystems	Engage with government stakeholders and like-minded organisations. Work with MPs already making the case for tax reform.
A regulatory framework that empowers innovation	Provide regulatory exceptions and special categories for STEM start-ups, reducing compliance to allow for marketplace testing and to reduce compliance costs during the initial stages of invention.	Regulatory frameworks, particularly in the STEM space, are frequently legislated with larger corporations in mind, often inhibiting innovation by resource-poor start-ups.	Identify key regulations inhibiting STEM start-ups and work towards regulatory frameworks that balance the commercial interests with start-ups, those of the consumer, and safety.



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Commercialisation of engineering innovation

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