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A stylized white outline of a human head profile is superimposed on a dark blue background filled with glowing digital lines, data points, and abstract shapes, suggesting a focus on technology and innovation.

BOOSTING HIGH-IMPACT ENTREPRENEURSHIP IN AUSTRALIA

A role for universities

OCTOBER 2015

Prepared by Spike Innovation for
the Office of the Chief Scientist.



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SPIKE INNOVATION
ACCELERATING GROWTH

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FOREWORD



In popular culture the entrepreneur is the rogue genius who succeeds without—or in spite of—education. And it would be extremely convenient if that were true.

If we cannot teach entrepreneurship, we can only recognise the born entrepreneurs; and get out of their way whilst they get on with the business of change.

Yet nations across the world have *not* been content to wait for the one-in-a-million person to seize a once-in-a-lifetime chance. From the United States to Korea, fostering entrepreneurs has become a national priority, pursued with energy, ambition and imagination.

These efforts stem from a shared understanding born of experience: that entrepreneurialism *can* be encouraged, and industries transformed as a result.

Entrepreneurship is an economic activity, requiring attention to the framework conditions for business creation and growth. But more importantly, it is a human endeavour, requiring attention to the way that our attitudes are shaped, our skills developed, our networks formed.

And so it is inseparable from education—not independent of it.

In September 2014, I called for the Australian Government to build entrepreneurship into education at all levels, as part of a national strategy to prepare Australia and Australians for prosperity through innovation in the decades ahead.

This report was commissioned to provide an evidence base for effective action at scale. We sought, in particular, to

understand how to encourage entrepreneurs to capitalise on science, technology, engineering and mathematics through universities.

Not all entrepreneurs have a background in science, technology, engineering or mathematics, but many do; and all will need to harness those disciplines to make a business competitive at the global scale. And universities are pivotal, as the stories of so many of the world's most iconic entrepreneurs suggests. Some grew their businesses from university-affiliated research; many more were shaped by the people they met and the attitudes they imbibed.

As this report reiterates, we too can work consciously to broaden our students' opportunities—or we can narrow their choices by default to the well-trodden paths.

The present focus on universities does not exclude the need to act in schools. If students come to higher education with their attitudes hardened, they will not see or welcome its possibilities. You do not make a cake by icing a brick. You *can* approach education at all levels as a process of enabling inquiry, encouraging creativity and opening horizons.

We *all* need to shift our mindsets to make the future envisaged by this report, from a willingness to muddle along to a determination to make our luck.

Our entrepreneurial Australia is ours to create.

Professor Ian Chubb AC
Chief Scientist for Australia
October 2015

EXECUTIVE SUMMARY

The global economy is changing, and with it, the skills required to succeed. Knowledge—and the capacity to acquire it, manage it and apply it—is the foundation of the high-growth industries of the future.

Australia has not fully bridged the gap between the creation of knowledge and its application.

When compared with 11 Western European countries, the United States and Canada, Australia performs well in the share of the world's top 1 per cent of cited research papers in Science, Technology, Engineering and Mathematics (STEM).¹ We place ninth for the quality of our scientific institutions.² Yet we only place 72nd for Innovation Efficiency, a measure of innovation output relative to input in the Global Innovation Index (2015). There are no Australian universities in Reuters' ranking of top 100 innovative universities.*

Less than one in two Australian businesses report innovative activity of any kind—whether product, process, or strategy. Very few take new products and services to market.

A lesson from other countries is that new knowledge in itself is not enough to catalyse broad-based change across an economy.

An important missing link between knowledge and its application is the entrepreneur.

AN INCREASINGLY ENTREPRENEURIAL WORLD

Entrepreneurs start and build businesses. The entrepreneurs who create the greatest economic impact are those who build high-growth businesses with global ambitions and the ability to disrupt large markets using technology. Around the world, these technology-based businesses drive productivity growth, create high-value jobs and boost living standards. Governments at all levels are increasingly adopting economic policies aimed at stimulating the creation of high-growth firms and supporting them as they grow.

Producing entrepreneurs is now seen as an economic priority, and teaching high-impact entrepreneurship has become an important role for universities.

LEARNING FROM COUNTRIES WITH SUCCESSFUL ENTREPRENEURIAL CULTURES

Countries with high levels of technology entrepreneurship have government policy settings that support an entrepreneurial ecosystem. In countries such as Israel, South

Korea, the UK and the United States, certain common characteristics emerge in an analysis of the global leaders:

1. They support the growth of technology companies through a range of policy measures and programs specifically aimed at firms with the greatest capacity for growth.
2. They start early, introducing entrepreneurship in schools and immersing university students in a diverse range of entrepreneurship programs.
3. Leading countries make technology entrepreneurship a priority, backed by a national strategy that recognises the role of universities as drivers of entrepreneurial culture.
4. They expose young people to the best international startup ecosystems and cultures in order to produce entrepreneurs who think globally.

Singapore is taking active steps to foster an entrepreneurial ecosystem. It has committed over A\$1 billion to boosting innovation and entrepreneurship over the five years to 2015, with the stated goal of shifting the country's economy from labour-driven to productivity-driven industries by supporting research, innovation and entrepreneurship. It has done this alongside a A\$13 billion boost to R&D expenditure in recognition of the importance of science as a basis for technology-based industries.

Similarly, South Korea launched its A\$4 billion Creative Economy Initiative in 2013 with the aim of stimulating the creation of new high-growth businesses and accelerating the growth of its technology sector through high-impact entrepreneurship.

Australia has been slow to embrace entrepreneurship as a driver of economic growth. Our policy environment does little to encourage or support high-impact entrepreneurs despite the fact that we are economically exposed as a nation heavily reliant on commodity industries.

UNIVERSITIES ARE CENTRAL

Regions with successful entrepreneurial cultures have a vibrant university sector that encourages and fosters entrepreneurship. Stanford and MIT have produced graduates who have gone on to create 39,900 and 25,800 companies respectively, generating an estimated US\$2.7 and US\$3.3 trillion in annual revenues. Many of these companies are based on technology spanning a diverse

* Reuters, *The world's most innovative universities*, (2015), <http://reuters.com/most-innovative-universities>

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

range of disciplines such as software, biotech, advanced manufacturing and cleantech.

Producing and training entrepreneurs is not seen as a priority for most Australian universities. Several universities have introduced promising initiatives, but many of the existing programs are too small, do not engage students in STEM disciplines, or do not reflect international best practice. This is compounded by limited engagement between universities and industry.

Higher education expenditure on STEM research was A\$7 billion in 2012, but there has been little focus on ensuring universities help drive economic growth.

A new approach is required to expose STEM students to entrepreneurship and to support them in building businesses that will compete globally.

Analysis by PricewaterhouseCoopers (PwC) shows that technology startups could contribute over A\$100 billion of additional Gross Domestic Product (GDP) by 2033, but only if we increase the number of high-impact entrepreneurs by a factor of 20 and improve the supportiveness of the ecosystem in which they operate. Universities and government have important roles to play in bridging this gap.

A WAY FORWARD FOR AUSTRALIAN UNIVERSITIES

This report identifies the skills and attitudes that STEM graduates require to become the next generation of entrepreneurs. It shows how universities can teach these skills and provide an environment that encourages students to explore high-impact entrepreneurship as an alternative to traditional career paths.

This report studies several universities with impressive track records as breeding grounds for entrepreneurs, and finds the following common attributes:

- ▶ Strong engagement between the university and the local startup ecosystem
- ▶ Courses delivered by experienced entrepreneurs
- ▶ Students given multiple opportunities for engagement—ranging from short courses to immersive programs such as internships and overseas placements
- ▶ Programs support multi-disciplinary collaboration that includes STEM

- ▶ Emphasis on experiential programs and learning by doing
- ▶ Funding arrangements with government drive investment in establishing and delivering student entrepreneurship programs that operate at significant scale
- ▶ Recognition and reward for academics who engage in student entrepreneurship activities
- ▶ Programs based on modern startup approaches such as Lean Startup.

Learning from best practice, and translating effective programs to the Australian context, will be an important step towards boosting Australia's entrepreneurial capabilities.

Australia needs to become known as an entrepreneurial country, not a lucky one.

Now is the right time for the government and the university sector to work together with industry to bring about a transformation in which high-growth, technology-based businesses become a driving force behind Australia's economy.



Colin Kinner
Director—Spike Innovation
October 2015



About the author

Colin Kinner is director of Spike Innovation, a consulting firm that specialises in development and implementation of entrepreneurship programs focused on high-growth technology companies.

Colin is an experienced entrepreneurship educator, having delivered entrepreneurship training and coaching to hundreds of aspiring entrepreneurs. He is also an active early-stage investor and a mentor to a number of startup founders, project director for the Startup Catalyst Silicon Valley program, and an active advocate for the national tech startup ecosystem.

Colin has previously run a startup incubator, served on the boards of a number of venture-backed technology companies, and held senior roles in the commercialisation arms of several universities in Australia and the UK.

1 Office of the Chief Scientist 2014, Benchmarking Australian Science, Technology, Engineering and Mathematics. Australian Government, Canberra

2 WEF Global Competitiveness Index 2014-15

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A NOTE ON TERMINOLOGY

Terminology is challenging in any discussion of the economic impact of entrepreneurship, not only because of the large number of terms in common use, but also because the same terms are used by different groups to mean different things. For clarity, this report adopts the following definitions:

High-growth company	A company that grows rapidly. Many are technology-based, although technology is not an essential criterion.
High-tech company	A company whose products or services are based on new technology being developed and commercialised by the company. Often this technology is the basis for high growth as it confers a competitive advantage.
High-impact company	A company that is based on innovation and delivers significant job creation, economic impact and societal impact.
High-impact entrepreneurship	The act of starting and growing a high-impact company.
Tech startup (often shortened to “startup”)	<p>A recently formed company that has the potential for high growth and is using either new technology or business model innovation coupled with existing technology (eg. the internet) as an enabler of growth.</p> <p>The Crossroads report commissioned by StartupAUS (Australia’s peak body for startups) defines a startup as “an emerging high-growth company that is using technology and innovation to tackle a large and most often global market.” It further notes that startups have two important defining characteristics, being potential for high growth (for which the ability of companies to raise capital from investors is a good proxy) and disruptive innovation, the process by which new entrants displace established competitors through use of technology and business model innovation.¹</p>
Small business	A business with fewer than 20 employees. ²

1 C. Kinner, StartupAUS, *Crossroads*, (2014), <https://startupaus.org/resources/crossroads-report/>.

2 E. Connolly, D. Norman, T. West, Reserve Bank of Australia, *Small Business: An Economic Overview*, (2012), [http://www.abs.gov.au/websitedbs/d3310114.nsf/f/4a256353001af3ed4b2562bb00121564/d291d673c4c5aab4ca257a330014dda2/\\$FILE/RBA%20Small%20Business%20An%20economic%20Overview%202012.pdf](http://www.abs.gov.au/websitedbs/d3310114.nsf/f/4a256353001af3ed4b2562bb00121564/d291d673c4c5aab4ca257a330014dda2/$FILE/RBA%20Small%20Business%20An%20economic%20Overview%202012.pdf).

CHAPTER 1

THE IMPORTANCE OF ENTREPRENEURSHIP

KEY POINTS

- ▶ High-impact entrepreneurship is about building high-growth businesses based on technology and innovation.
- ▶ These businesses drive economic impact, enable access to global markets and create high-value jobs.
- ▶ Many high-growth businesses are based on technology and require a combination of STEM skills and entrepreneurial skills.
- ▶ Australia has a strong STEM base, but relatively few high-impact entrepreneurs.
- ▶ To secure Australia's economic future we need significantly more STEM graduates to become high-impact entrepreneurs and build globally competitive technology companies.

WHAT IS ENTREPRENEURSHIP?

At its simplest level, entrepreneurship is the act of starting any kind of new business. By this definition, Australia performs comparatively well. There are around 2 million small businesses in Australia, around two thirds of which have no employees, and business formation rates have been steadily increasing since 2008.³ In 2011, 10.5 per cent of the Australian adult population were estimated to be actively engaged in starting and running a business (a rate second only to the United States among developed countries)⁴ and 132,000 “start-ups” (defined as businesses under three years old) were recorded.⁵

Most small businesses start and forever remain small, providing largely undifferentiated products and services, operating only in domestic markets, and in many cases serving customers only in small geographic areas such as cafés, restaurants and small retailers.

A rare few do have the potential to grow to global scale and grow the national economy substantially in turn. They, and the individuals who create them, are the focus of this report.

High-impact entrepreneurs are those who start and grow businesses that are innovation-based, tackle large opportunities, and if successful, grow rapidly to create large numbers of jobs and deliver significant economic impact.

According to the World Economic Forum, high-impact entrepreneurship can be defined with reference to four essential criteria:^{6,7}

- ▶ **Innovation**—The company creates significant benefits for customers through new-to-world products or services, often based on new technology or business model innovation.

Australian example: *ResMed, a manufacturer of devices for diagnosis and treatment of respiratory conditions, has improved the quality of life for millions of patients worldwide with sleep-disordered breathing and chronic obstructive pulmonary disease.*

- ▶ **Job creation**—The company creates large numbers of high value and high skill jobs as it grows.

Australian example: *Cochlear, a manufacturer of cochlear implants for the hearing impaired, created 1,408 new jobs over the period 2005 to 2012. Of its total workforce, 40 per cent have a tertiary qualification and 48 individuals have PhDs or other postgraduate qualifications.*

- ▶ **Wealth creation**—The company directly generates significant wealth for the founders, employees and investors, and indirectly for the economies in which they operate.

Australian example: *SEEK, an online job listings company, grew from inception in 1997 to current revenues of A\$756 million and a market capitalisation of A\$3.6 billion. Not only did the founders, employees and investors benefit from this wealth creation, but also the Australian economy via tax revenues and the formation of multiple new startups and venture capital funds by its founders and early employees.*

- ▶ **Societal impact**—The company has a positive impact on an important aspect of society such as human health, the environment, education or industry transformation.

Australian example: *Pharmaxis, a pharmaceutical company, develops new drugs to treat and manage respiratory diseases such as asthma and cystic fibrosis, which affect over 300 million people worldwide.*



In my opinion, the career advice students receive: study what you like, graduate, apply for graduate job at a consulting, finance or other established company—is outdated and wrong, and heads students into career paths that probably won't exist in five years time.

James Alexander

Founder of INCUBATE, a student startup incubator at The University of Sydney

High-impact entrepreneurs make up a very small fraction of all new businesses by number, but deliver disproportionate economic benefits due to their much greater capacity to grow their operations beyond local geographic boundaries and operate in global markets.

A 2011 World Economic Forum study found that the top 1 per cent of firms contribute 44 per cent of total revenues and 40 per cent of total jobs, and that these firms are characterised by having the highest rates of growth and being based on innovation and technology.⁸ Research from around the world^{9,10} has shown that new businesses are net job creators, whilst existing businesses are net job destroyers.

Similarly, the UK's Centre for Economics and Business Research found that the 1 per cent of UK businesses with the highest rates of growth generated 68 per cent of all new jobs created in 2012–13.¹¹

In Australia, the Office of the Chief Economist in the Department of Industry and Science found that a very small fraction (3 per cent) of startups (0–9 employees) drive the majority (77 per cent) of startup post-entry job creation, a finding that is consistent with other OECD countries.¹²

For individuals, high-impact entrepreneurship provides an opportunity to create wealth, to control their own economic future, to gain experience that is valuable in future ventures and as an employee, and to have a meaningful impact on entire industries.

For Australia, it is the path to wealth and job creation in a global economy defined by its disrupters.

THE OPPORTUNITIES IN DISRUPTION

A recent report by PlayBigger¹³ highlighted a new winner-take-all dynamic occurring in many industries, in which the dominant company in a given category typically captures more than 70 per cent of that market's value in a relatively short period of time, leaving only a small slice of the global market for all other competitors.

Disruptive innovation is both an opportunity and a threat. Existing companies have everything to lose if their market share is rapidly eroded by a more innovative and agile new competitor. Startups, on the other hand, have everything to gain by being the disruptors and rapidly acquiring market share from older, slower and less innovative firms.

Based on the work of Professor Richard Foster of Yale University and global strategy consulting firm Innosight, the average lifespan of a major listed company is now just 18 years, down from a high of 67 years in the early twentieth century. Analysis by Innosight predicts that at the current rate of company replacement, by 2027 three quarters of the S&P 500 will consist of companies that were unknown at the beginning of this century.^{14,15}

The acceleration of this process means that relying on established companies for future economic growth and jobs is becoming a less viable strategy as the average age of large firms decreases and a larger share of economic output is attributed to new entrants.

One need only look at the rate of growth of companies such as Google (market capitalisation of A\$600 billion, largely from disrupting traditional advertising), Uber (market capitalisation of A\$70 billion from disrupting the taxi industry), AirBnB (market capitalisation of A\$30 billion from disruption of the hotel industry) to see the pace

at which economic wealth is being transferred from established companies to new ones, and without regard for geographic boundaries. Digital innovation is of course a significant enabler of this transformation, but it can also be seen in many other industries such as energy (solar and battery storage replacing traditional power generation) and manufacturing (3D printing replacing an increasingly wide range of traditional manufacturing processes).

The impact of this dynamic for Australia is that if we are to prosper in this new world of rapid disruption and renewal we will need to become proficient at starting and rapidly growing companies that can become category leaders.

A CLOSE RELATIONSHIP WITH STEM

Many high-impact companies have their roots in STEM due to the important role of STEM in creating technology that can be the basis for differentiated products and services, and in conferring a competitive advantage that enables businesses to grow rapidly.

In Israel, a massive 70 per cent of the country's industrial product has been attributed to high-tech companies¹⁶ and today the high-tech industry accounts for over 26 per cent of Israel's exports.¹⁷ In the ten years to 2012, 772 Israeli startups were acquired for a total of A\$60 billion.¹⁸ Israel now has more companies listed on the NASDAQ exchange than any country outside the United States, despite having a population of only eight million people.

Similarly, it has been estimated that science, innovation and entrepreneurship are responsible for roughly half of all US economic growth in the last 50 years.¹⁹

In 2013, PwC quantified the potential economic impact to Australia of increasing the number of tech startups and better supporting them to become globally successful

companies. The resulting analysis²⁰ showed that technology-based startup companies could contribute 4 per cent of GDP (over A\$100 billion) and add 540,000 jobs to the Australian economy by 2033 from a current level of approximately 0.2 per cent of GDP.

The opportunities to derive value from STEM skills go far beyond digital companies. Australia has world-class research and teaching capabilities in biotechnology, drug discovery, medical devices, cleantech, agriculture and robotics—to name just a few. Australia has already demonstrated the capacity to create globally impactful high-tech companies such as ResMed, Cochlear, Pharmaxis and Spinifex, as well as products that are brought to market by others such as the Gardasil® cervical cancer vaccine developed at The University of Queensland and licensed to CSL and Merck.

CREATING A NEW ECONOMY AND NEW JOBS

Recent reports by PwC²¹ and CEDA²² show that more than 40 per cent of current Australian jobs (or 5 million jobs) are at risk of being displaced by computerisation and automation over the next 10 to 20 years.

The Foundation for Young Australians estimates²³ that 60 per cent of Australian university students are training for jobs that will not exist in the future due to computerisation and automation.

The jobs that are at risk are not just low-skill jobs that can be replaced by automation, but also highly skilled jobs across many sectors including healthcare and professional services.

The only way to be ready for this change is to embark on a deliberate path of economic reform in which we set out to create a new economy and new jobs based on innovation and entrepreneurship.



Universities must ensure that students graduate with a mix of skills that will equip them for their professions, not just as they are now, but as they will be in ten or twenty years' time.

As the nature of employment changes, the ability to be flexible, adaptive, and proactively seek out problems and design solutions for them will become ever more important. Developing programs that encourage interdisciplinary, solutions-based learning for students, support enterprise and independence, and reward an entrepreneurial mindset is one of our top educational priorities.

Professor Margaret Gardner AO
President and Vice-Chancellor, Monash University



In the last few years the AGSM has seen a massive increase in demand for graduates with a grounding in entrepreneurship, particularly among organisations that are facing disruption from startups. To meet this demand we are exposing students to entrepreneurship in an experiential setting by providing them with internships in tech startups, and through high-quality entrepreneurship education delivered by experienced entrepreneurs.

Entrepreneurship is now a central part of what we teach every student, and I strongly endorse the notion that all Australian universities should equip graduates across all disciplines with a practical grounding in entrepreneurship.

Julie Cogin

Director, Australian Graduate School of Management, UNSW

In his book *The New Geography of Jobs*,²⁴ Enrico Moretti shows that technology-based jobs have a larger multiplier effect than jobs in any other sector. For each new technology-based job, five additional jobs are created in other sectors. This multiplier effect is three times larger in the technology sector than in extractive industries or traditional manufacturing, accounting for employment growth in the US technology sector being 25 times that of other parts of the economy.

ENTREPRENEURS WITHIN LARGE ORGANISATIONS

Entrepreneurs are a vital ingredient in the formation of startups. They are often the ones who see opportunities and go after them, managing risk.

Entrepreneurial mindsets are also valuable in the workforce. Employers are increasingly seeking graduates with entrepreneurial experience and skills to act as internal entrepreneurs (or “intrapreneurs”). This trend has accelerated in recent years as more companies realise that their industries are facing disruption from startups and they need to learn to innovate more effectively than ever before.

Entrepreneurship is a skill set with a broad application. This is important and helpful to many, not only those who choose to pursue a career as an entrepreneur. Producing entrepreneurially-wired and skilled employees is another important role for Australian universities as a means of boosting the performance of existing businesses.

Some of the benefits achieved by established companies in embracing entrepreneurial attitudes and skill sets include:

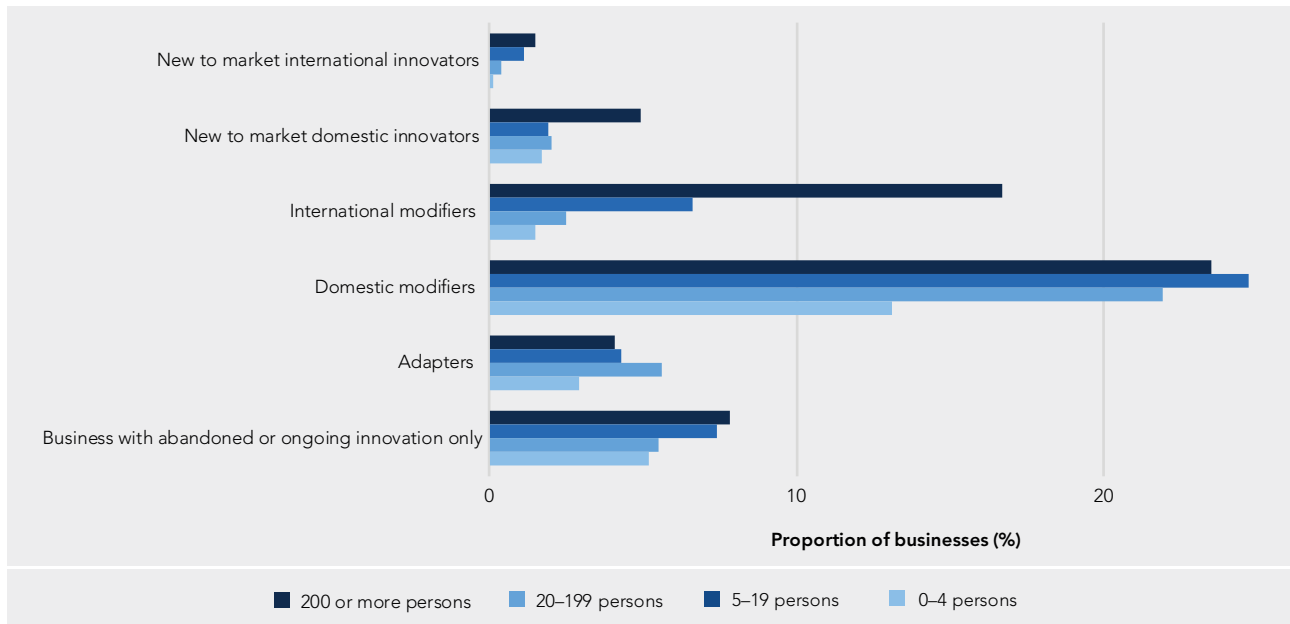
- ▶ Greater tolerance for risk and failure
- ▶ Increased emphasis on innovation as a driver of growth
- ▶ Focus on large opportunities and global markets rather than small domestic niches
- ▶ More agile approach to product development
- ▶ Adoption of Lean Startup approaches that result in faster product iteration
- ▶ Increased engagement with entrepreneurs outside the organisation, leading to greater awareness of emerging trends
- ▶ Opportunities to engage with or acquire startups as a means of developing new products and revenue streams
- ▶ Greater willingness to act quickly on opportunities rather than undertake lengthy analysis.

TAKING STOCK OF OUR POSITION

As a country, Australia produces an average of 43,000 STEM research publications annually, ranking it tenth in the world.²⁵ Its residents also filed approximately 1,979 standard patent applications domestically in 2014, and 9,012 internationally in 2013.²⁶ Australia also ranks 13th out of 200 countries in R&D expenditure as a percentage of GDP²⁷ and its 43 universities produced 25,000 domestic STEM graduates in 2012.²⁸

Australia is good at producing research outputs, but performs relatively poorly in converting this investment in science and technology into economic impact. The 2015 Global Innovation Index²⁹ ranked Australia 72nd in the world in Innovation Efficiency, a measure of innovation output relative to input.

Figure 1: Proportion of different types of innovators, by firm size, 2008–09



According to the Office of the Chief Economist in the Department of Industry,³⁰ Australia compares poorly with many other countries on measures of new-to-world innovation (in which a business is the first in the world with a particular new product or service), and our innovation performance has been declining for over a decade.

As can be seen in Figure 1, based on the Business Characteristics Survey conducted by the ABS, emerging Australian firms are primarily domestic modifiers of innovation (replicating technology and innovation seen elsewhere) and internal innovators (making improvements to internal processes and practices), with relatively little emphasis on new-to-market innovation.³¹

New-to-market international innovation is important for economic growth, since it increases exports, boosts economic diversity, helps to rapidly capture market share, and allows firms to engage in global rather than purely domestic industries.

Available data indicates that there are around 1,200 tech startups in Australia, which represents 0.06 per cent of all Australian businesses. The roughly 2,000 entrepreneurs who founded these companies are a small fraction of the 43,000 startup founders that PwC estimates will be needed by 2033.³²

Comparing startup formation rates in Australia with other countries highlights a significant gap. The National Survey of Research and Commercialisation reported that in 2013, 0.4 startups per US\$100 million research expenditure were formed in Australia. In comparison, 1.5 and 1.3 startups were formed per US\$ 100million research expenditure in Canada and US respectively.* Research by Boundlss³³ in 2014 estimates that in Australia around 20 to 30 tech startups are formed annually per million people, compared to annual startup formation rates of between 100 and 250 startups per million people in startup hotspots such as Boulder, Silicon Valley and San Francisco.

As can be seen in Figure 2, the total number of tech startups in Australian cities is low in a global context.³⁴

A similar observation can be made about the rates of startup formation from graduates of Australian universities. Figure 3, based on analysis by global startup database CrunchBase, shows that Australian universities are producing fewer graduates who form startups than many overseas institutions.³⁵

* National Survey of Research Commercialisation is authored by the Department of Industry, Innovation and Science. <http://www.industry.gov.au/innovation/reportsandstudies/NSRC/Pages/default.aspx>

Figure 2: Startups per million people (2013–2014)

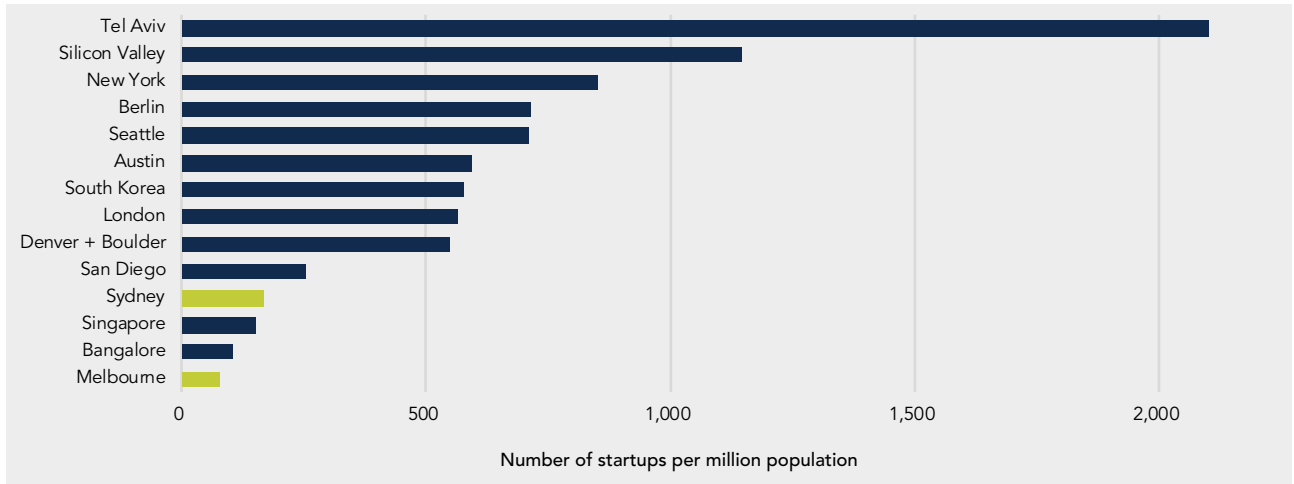
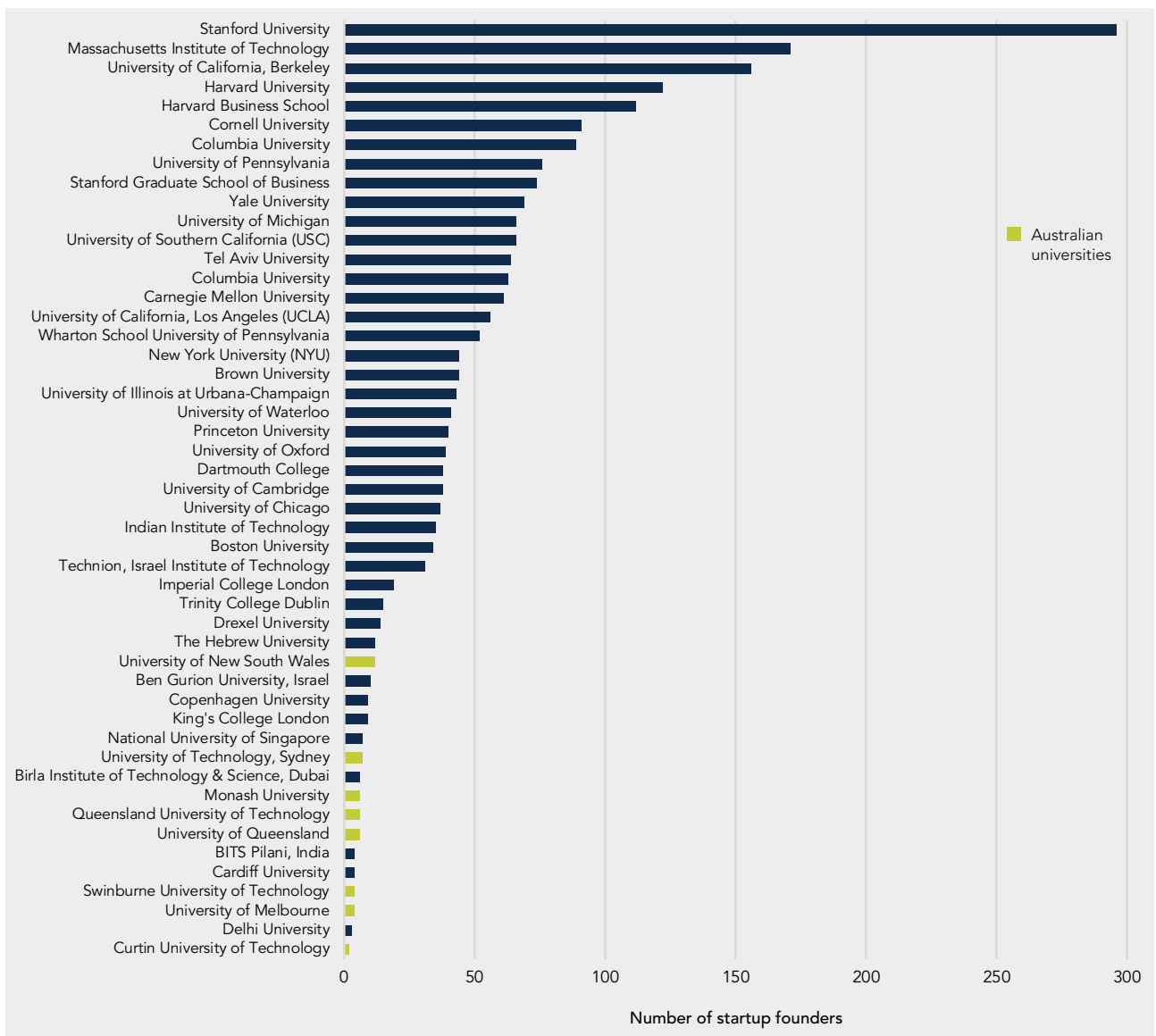


Figure 3: Total startup founders by university, based on startups currently listed on CrunchBase (August 2013)





Entrepreneurial skills are not just for startups. Employees with entrepreneurial skills are also extremely sought-after in large organisations, such as Google.

We find that such employees can identify opportunities, and use their initiative and drive to find solutions that are not apparent to others.

The common trait, whether the founder of a startup, or an “intrapreneur” working within a multinational, is the single-minded passion to be an agent for change and to make it happen.

Alan Noble

Engineering Director, Google Australia

Deloitte and Pollenizer compared tech startups in Australia and Silicon Valley, and found that Australian startups are significantly less likely to be focused on markets worth a billion dollars or more. This may be in part due to the fact that Australia has relatively few young startup founders and therefore relatively few startups that are tackling the riskiest, but often most lucrative opportunities.³⁶

If Australia is to reap the economic benefit of its investment in STEM we must not only produce STEM graduates, but also ensure they are willing to become entrepreneurs, are equipped with the right skills, and can grow successful global businesses that employ a diverse range of people.

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CHAPTER 2

**LEARNING FROM THE
GLOBAL LEADERS**

KEY POINTS

- ▶ A growing number of countries are producing high-impact entrepreneurs by exposing them to startups during university and teaching practical skills needed to grow technology-based businesses.
- ▶ Universities in many countries view producing entrepreneurs as an important part of their role, and are funded to do so.
- ▶ Most Australian universities do not emphasise high-impact entrepreneurship, and funding arrangements do not incentivise entrepreneurial behaviour, teaching or engagement.
- ▶ Entrepreneurship education in most Australian universities is delivered by academics with limited first-hand experience of entrepreneurship, and generally focuses on business students.
- ▶ Australia is the only country in the OECD that does not have a science and innovation strategy, and lacks a consistent narrative about how the country will transition to a knowledge-intensive economy.³⁷
- ▶ A comprehensive innovation and entrepreneurship policy is needed.

THE GLOBAL RACE TO PRODUCE ENTREPRENEURS

Over the last two decades, the world has witnessed a rapid escalation of international efforts to produce more entrepreneurs and better support them. Before reviewing specific initiatives in individual countries it is important to consider which countries have performed well in innovation and entrepreneurship.

Table 1 shows the top 10 countries (or cities in the case of the Compass study) ranked by measures of entrepreneurship and innovation performance. Whilst the studies set out to measure different aspects of the ecosystems for innovative and entrepreneurial firms, they can be a useful guide to countries consistently identified as top performers.

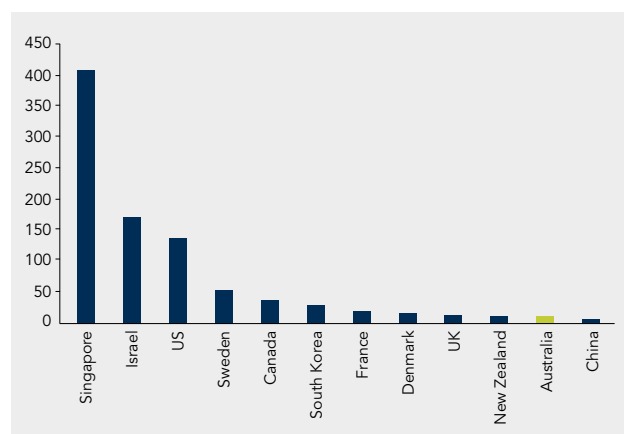
Table 1: Top 10 countries ranked by measures of entrepreneurship and innovation performance

Source	Top 10 ranked countries (cities) on measures of entrepreneurship and innovation performance
Compass Global Startup Ecosystem Ranking 2015 ³⁸	Measures: Startup ecosystem performance, availability of funding, talent, market reach and startup experience Top 10 cities: Silicon Valley, New York City, Los Angeles, Boston, Tel Aviv, London, Chicago, Seattle, Berlin, Singapore Sydney ranked: 16
World Economic Forum Global Competitiveness Report 2014–15, Innovation Ranking ³⁹	Measures: Conduciveness to technology innovation and whether supported by the public and private sectors Top 10 countries: USA, Finland, Germany, Israel, Japan, Netherlands, Singapore, Switzerland, Sweden, China Australia ranked: 25
Global Innovation Index 2015 ⁴⁰	Measures: A broad range of innovation measures such as research, business sophistication, human capital and technology outputs Top 10 countries: USA, Switzerland, UK, Sweden, Netherlands, Finland, Singapore, Ireland, Luxembourg, Denmark Australia ranked: 17

A further measure that may assist in identifying top-performing countries is deployment of venture capital. Companies that are growing rapidly and tackling large markets very often need access to venture capital to fuel their growth. An analysis of domestic availability of venture capital is a measure of supportiveness of a country's ecosystem toward high growth companies.

Figure 4 shows domestic venture capital investment per capita of population for a selection of countries.⁴¹

Figure 4: Domestic venture capital investment—selected countries, latest available data (A\$ per capita of population)



Based on the rankings in Figure 4 and measures of venture capital availability, plus a review of national approaches to fostering entrepreneurship, the following countries have been selected for further discussion (Table 2).

Table 2: Rationale for selection of comparator countries

Country / region	Reason for inclusion
United States	Ranked highly for innovation and entrepreneurship, strong cultural support for high-impact entrepreneurship over many decades
UK	Ranked highly, substantial government commitment to support high-impact entrepreneurship, particularly over the last decade
Israel	Substantial government commitment to spurring technology innovation and entrepreneurship over a period of more than 20 years
Singapore	Ranked highly, government commitment to spurring innovation and entrepreneurship in recent years
South Korea	Substantial government commitment to spurring innovation and entrepreneurship in recent years

All of these countries are actively seeking to create an environment that is conducive to high-impact entrepreneurship, and are using the education system to expose students to entrepreneurship and equip them with practical skills that will enable them to build globally competitive companies.

It is important to note that many countries have not had high-impact entrepreneurship policies in place for long enough to have generated significant measurable economic outcomes. However it is widely accepted that governments have levers available to them to influence the shape of their national economies, and that these should have a strong focus on science, innovation and entrepreneurship.

UNITED STATES

The US Government has a broad range of policies aimed at supporting high-impact entrepreneurship. This includes the Small Business Innovation Research (SBIR) program, a funding initiative that encourages small businesses to conduct research and development in response to specific US government needs. The objectives of the SBIR program include stimulating technological innovation and encouraging participation in entrepreneurship. It allocates approximately A\$3.5 billion per annum to high growth-potential firms that could contribute to the US economy, but have not yet reached a stage of development where they could attract venture capital investment.⁴²

In 2011, the Startup America Partnership was launched to further support high-impact entrepreneurship as an economic priority. This A\$2.8 billion suite of programs focuses on encouraging high-growth startups in preference to small businesses, and seeks to leverage the existing strong culture of entrepreneurship that already exists in many parts of the country—particularly in Silicon Valley which has developed its own entrepreneurial culture over more than 60 years.

Entrepreneurship education has also been a feature of university life in the US since the early 1980s, and in many cases is supported through endowment funding—a feature of US universities that is largely absent in Australia.

Each year in the United States, over 400,000 students take part in entrepreneurship training across 1,500 institutions, delivered by 9,000 teaching staff.⁴³ Of the more than 1,200 incubators for startup in the US, around one third are on university campuses.

UK

The UK Government's Higher Education Innovation Funding (HEIF) program provides funding to support and develop a broad range of interactions between universities and industry aimed at achieving economic and social benefit to the UK.

The program has been running since 2001, and in 2015 the government allocated A\$350 million, of which around A\$35 million is specifically to support entrepreneurship training in universities.

HEIF funding has been used by universities in the UK for purposes such as hiring entrepreneurs-in-residence, running experiential education programs, work placements, business idea competitions and student startup incubators.⁴⁴

A review of the HEIF program in 2012 found that for every dollar of HEIF funding invested, six dollars of gross additional economic impact was generated.

One of the measures of impact of the HEIF funding was graduate startups formed. Since 2001 a total of 8,244 startups have been formed by graduates in the UK, representing a 42 per cent increase over pre-HEIF funding levels.⁴⁵

In addition, over the last decade the UK government has implemented a raft of policies and programs aimed explicitly at supporting high-growth, globally focused businesses. These include early-stage matching funds and tax incentives to stimulate angel investment, a loans scheme to provide seed capital and mentoring to early-stage businesses, funding to support the creation of new venture capital funds, and funding to support entrepreneurship programs in schools and universities. Many of these initiatives are overseen by Innovate UK, the UK's innovation agency, which has responsibility for a range of innovation programs and provides input to government innovation and economic development policy.⁴⁶

ISRAEL

Israel's transition to a technology-focused economy began in the early 1990s. One of the key factors in this transition was the government's Yozma program (Hebrew for "initiative"), a tax incentive and matching funding program launched in 1993 to catalyse an active venture capital industry and fuel the growth of high-tech Israeli companies.⁴⁷

In parallel, the government established a network of 22 technology-focused startup incubators that today support approximately 180 companies under the direction of the Office of the Chief Scientist. Each company accepted into an incubator is entitled to receive up to A\$880,000 in government funding via a repayable grant.⁴⁸ The government provides 85 per cent of the incubators' annual operating budgets, or A\$50 million per annum.

Through the combination of funding and dedicated startup incubators the Israeli government has helped launch over 1,700 companies, of which 60 per cent have successfully attracted private investment, with total investment in graduated incubator companies now exceeding A\$3.9 billion. It has also grown its venture capital industry from A\$58 million 1991 to A\$3 billion in 2011.⁴⁹ In the decade to 2012, 772 Israeli startups were acquired for a total of A\$46 billion, and the third quarter of 2013 saw 162 companies raise A\$725 million in private capital.⁵⁰

As a result, of the significant national focus on high-growth technology companies, Israeli universities have also embraced high-impact entrepreneurship and most provide a range of education and support programs to students, with a particular emphasis on STEM disciplines.

Countries that have directly replicated elements of Israel's approach to stimulating high-impact entrepreneurship include New Zealand, Singapore and South Korea.



Entrepreneurship is crucial to innovation and economic growth. Encouraging young students to develop their entrepreneurial skills is highly beneficial for the students as well as for the innovation ecosystem. Students are at a stage in their career in which they are very open to learn and try new things, and this is the essence of entrepreneurship. However, starting a new project or company might seem to some of them an obstacle too hard to overcome. It is our job to 'nudge' them to try and experiment with entrepreneurship while testing their abilities and potential.

Avi Hasson
Israel's Chief Scientist

SINGAPORE

In 2008, Singapore's President Tony Tan visited Tel Aviv and witnessed Israel's success in building a vibrant knowledge-intensive economy.

Shortly afterwards, the Singapore government launched its own National Framework for Innovation and Enterprise, based on the Israeli approach of boosting high-impact entrepreneurship through education and providing financial support to high-growth companies. The Singapore government has committed A\$1.1 billion over the five years to 2015 to boosting innovation and entrepreneurship as part of a broader A\$14 billion funding package for research, innovation and enterprise. Its stated goals include shifting the country's economy from labour-driven to productivity-driven industries by supporting research, innovation and entrepreneurship, and fostering the creation and growth of at least five local technology companies with annual revenues of more than A\$1 billion.^{51,52,53}

Specific university-based programs that have been supported by the Singapore government include entrepreneurship centres, summer schools, student startup accelerators and overseas immersion trips to startup hubs such as Silicon Valley, Beijing, Stockholm and Tel Aviv.

The Singapore government's suite of programs is overseen by the national innovation agency SPRING Singapore, and includes a network of 15 government-funded startup incubators, matching funds to catalyse formation of venture capital funds, government co-investment with private investors, a grants scheme to support startups by funding up to 50 per cent of technical staff salaries, and multiple programs to develop entrepreneurship education in schools and universities.⁵⁴

SOUTH KOREA

In 2013, the South Korean government announced the "Creative Economy" initiative, a A\$4 billion funding commitment to boost entrepreneurship and accelerate high-growth companies. The initiative is part of the government's efforts to reduce the country's dependence on low-value manufacturing and to stimulate creation of new high-growth businesses.

The Korean Creative Economy initiative is overseen by a newly created Ministry of Science, ICT and Future Planning, and includes a national startup promotion program to encourage more people to become entrepreneurs, free entrepreneurship education for primary, secondary, high school and university students and the general public, conversion of 1,000 public libraries into new "innovation centres" to incubate startup ideas and engage the population in entrepreneurial thinking, and funding for internships to place university students within growing startups.

CHARACTERISTICS OF COUNTRIES WITH SUCCESSFUL ENTREPRENEURIAL CULTURES

A review of the above policies and programs show that countries that emphasise high-impact entrepreneurship have a number of common attributes:

- ▶ A national strategy that places high-impact entrepreneurship as an economic priority and seeks to address known obstacles
- ▶ A national agency with oversight of innovation and entrepreneurship programs
- ▶ Clear emphasis on high-impact entrepreneurship (as opposed to small business entrepreneurship)
- ▶ Government ensures that funding arrangements with universities drive investment in establishing and delivering student entrepreneurship programs that operate at meaningful scale and in line with best practice
- ▶ A wide range of complementary programs that address multiple aspects of the entrepreneurial ecosystem, including education, access to finance, culture, technical skills and startup expertise
- ▶ Aim to engage young people in high-impact entrepreneurship via school and university-based programs
- ▶ Deliberate efforts to connect to global markets and develop a born-global culture in which companies by default set out to tackle global rather than domestic markets.

BARRIERS TO ENTREPRENEURSHIP IN AUSTRALIA

The following section explores some of the specific barriers to boosting high-impact entrepreneurship in Australia, in comparison with the environments that have proved most conducive to startup activity overseas.

Findings are drawn from a literature review supported by interviews with more than 40 stakeholders including university executive leaders, current students and graduates, investors, entrepreneurs and those involved in delivering university-based student entrepreneurship programs.

THE ENTREPRENEUR CHICKEN-AND-EGG PROBLEM

It has been postulated⁵⁵ by futurist and author Paul Wallbank that if Bill Gates had been born in Australia he would most likely not have become a successful technology entrepreneur, but would instead have been encouraged to pursue a “safe” career such as law, due to our strong cultural aversion to risk, our lack of regard for successful entrepreneurs and our strong endorsement of people who conform to societal norms. Wallbank goes further to suggest that a successful Australian Bill Gates would have also been a property speculator as a consequence of Australia’s tax laws artificially incentivising investment in property ahead of other asset classes, despite property having no impact on economic value creation.

In reality, successful companies like Microsoft have played an important role in producing hundreds of new entrepreneurs in locations such as Seattle.

As noted by Paul Graham, founder of Silicon Valley’s most successful startup accelerator, Y Combinator, “Startups beget startups”.⁵⁶ Startup hubs grow when founders and employees of successful startups leave to create new startups and invest in others. Experienced serial entrepreneurs also play an important role as mentors to less experienced founders.

This virtuous cycle, coupled with a strong pro-entrepreneurship culture and supportive economic environment, has been instrumental in the continued growth of the startup hotspots such as Silicon Valley, New York and Tel Aviv.

In more recent times, countries such as Singapore, Sweden and the UK have introduced deliberate measures to stimulate the formation of startups, including education programs to produce more entrepreneurs, and injecting successful entrepreneurs from overseas to help bridge the expertise gap whilst the local talent pool matures to a point where its growth can become self-sustaining.

Australia has historically had a limited focus on high-impact entrepreneurship as a driver of economic growth, and tech startups are a relatively new phenomenon, with most elements of the country’s startup ecosystem having come into existence in the last five years.

Without a steady supply of experienced and successful entrepreneurs advising first-time startup founders, we risk a continuation of the current situation in which much of the advice given to startup founders is flawed because it comes from well-intentioned individuals who simply do not have first-hand experience in building and scaling technology companies globally.



One of the secrets of entrepreneurial success is to be risk-inclined. I walked away from my funded postdoctoral fellowship at the ANU many years ago to start a one-man company in America.

Another secret of success is to know how to build the product that you want to sell. When I left the university I had in my head all the knowledge that I needed to design my initial product. The combination of taking a risk and being an expert worked well, and was followed by more than twenty years of corporate growth.

Dr Alan Finkel AO FTSE

Chancellor of Monash University and President of ATSE (Australian Academy of Technological Sciences and Engineering)



Twenty years ago in the United States the Kauffman Foundation began providing grants to universities to infuse entrepreneurship throughout the curriculum. Entrepreneurial concepts were taught in a variety of formats—during student orientation, in the classroom, through business plan competitions, in entrepreneurship clubs, via space and support for student entrepreneurs creating companies, through alumni who came back as visiting entrepreneurs and mentors, and sometimes as investors in student companies. We need to develop such a system in Australia.

Jana Matthews

ANZ Chair in Business Growth and Director, Centre for Business Growth,
University of South Australia Business School

UNIVERSITIES DON'T SEE PRODUCING ENTREPRENEURS AS THEIR ROLE

Compared with universities in the best-performing entrepreneurial countries, Australian universities generally do not see producing entrepreneurs as a major part of their role. This view was consistently expressed in interviews with stakeholders in the university sector.

As a result, they generally do not invest in programs to create and nurture high-impact entrepreneurs to the same degree as universities in some of the global leaders.

Most university graduate career days appear to be dominated by traditional employers, and many career guidance officers appear to have little awareness of being an entrepreneur as a career. Indeed, most of the messaging universities direct to the student population and the wider community focuses on the importance of preparing graduates for the present “workforce”.

By contrast, universities in some countries see themselves as having a central role in educating and cultivating future entrepreneurs. The entrepreneurial track record of universities such as Stanford and MIT should be an exemplar. These two universities have produced graduates who have gone on to create over 65,000 companies that together generate nearly US\$6 trillion in annual revenues and employ around nine million people, many in high-value, knowledge-intensive jobs.^{57,58}

Every Australian vice-chancellor should ask: “Are there students at my university who are working on what could become the next Atlassian (or Radiata or Cochlear or ResMed), and what are we doing to help them?”

Some US universities such as CalTech, Stanford and Berkeley find that as much as 20 per cent of all students, and more than 50 per cent of computer science students, form a startup before they graduate.⁵⁵

According to Jerome Engel, who established the Lester Center for Entrepreneurship at UC Berkeley, in the United States there is “no longer any debate about whether entrepreneurship can be taught or whether universities have a role in fostering entrepreneurs.”⁶⁰

In comparison, students at most Australian universities receive little or no exposure to the idea of forming a startup, particularly in STEM disciplines outside of computer science. Coupled with our low overall cultural predisposition to creating tech startups, this illustrates the challenge to raising the level of high-impact entrepreneurship in Australia.

MOST UNIVERSITIES LACK AN ENTREPRENEURIAL CULTURE

The importance of creating a pro-entrepreneurship culture cannot be overstated. While influencing culture on a national level is not trivial, there are a number of known levers that are available to government and individual institutions.

Before seeking to influence culture it is important to fully understand the prevailing culture and the cultural changes that are desired. Table 3 outlines some observations regarding the cultural differences between startups and universities.

Without a culture that supports and celebrates entrepreneurship, it is less likely that graduates will be drawn to new venture creation.

Universities whose entrepreneurial aspirations are driven by senior leadership have the greatest chance of shifting attitudes toward entrepreneurship.

MOST ACADEMICS HAVE LIMITED EXPERIENCE OF ENTREPRENEURSHIP

The quality of student entrepreneurship courses depends heavily on the experience of those teaching the course. Involving educators who have first-hand experience in startups has been shown to deliver better outcomes than courses delivered by those with only academic experience. Unfortunately in Australia most academics teaching entrepreneurship courses do not have first-hand experience in a startup and therefore deliver courses that are heavy on theory and light on applied content.

Many are generalist business school teachers or researchers with a primarily academic interest in the topic of entrepreneurship.

One of the reasons for this is that Australia does not have a rich history of high-impact entrepreneurship, and very few academics have left the university system to pursue their own startup ideas.

ENTREPRENEURSHIP TEACHING IS OFTEN FOCUSED ON BUSINESS STUDENTS

Historically most entrepreneurship courses in Australian universities have been taught by business schools, whose expertise and focus mostly lies on working for companies and organisations.

However, most business schools do offer entrepreneurship subjects at an undergraduate and postgraduate level. Such courses are taken mainly by business and commerce students, and in many universities there has been relatively little emphasis on providing entrepreneurship training to students in STEM disciplines. The exception is perhaps courses in research commercialisation—which overlaps with, but is not the same as entrepreneurship.

Where entrepreneurship is taught outside the business school, it is often siloed in individual faculties or schools, making it difficult to engage meaningful numbers of students, and preventing the course from reaching a scale at which it can attract and retain high-quality external lecturers or achieve economies of scale.

A review of university entrepreneurship education programs conducted in 2014 by Professor Tim Mazzarol of the University of Western Australia⁶¹ found that 90 per cent of Australian universities teach entrepreneurship courses at postgraduate and 95 per cent at undergraduate level, and that these are mainly delivered by academic staff in business schools. It also found that programs tend to focus on small businesses rather than high-impact entrepreneurship, and

Table 3: Some cultural differences between startups and universities

Startups	Universities
Develop products quickly, launch early, high tolerance for imperfection and failure, iterate often and improve based on user feedback.	Longer timeframes, deliberate action, risk averse.
<i>"Move fast and break things."</i> —Facebook company motto	Publish papers when they are as close to perfect as possible, since research reputation and funding hinge almost exclusively on the quality of published papers.
<i>"If you are not embarrassed by the first version of your first product, you've launched too late."</i> —Reid Hoffman, Founder of LinkedIn	

often use existing companies as case studies rather than providing students with experiential learning opportunities such as creating their own venture or taking on an internship.

THE VALUE OF RESEARCH IS CONCEIVED TOO NARROWLY

Knowledge creation through research is vital to economic growth. As noted by Norman Augustine (past Chairman and CEO of Lockheed Martin Corporation and Co-Chair, American Academy of Arts & Sciences), science and technology are responsible for around two thirds of growth in GDP in the United States, despite the fact that scientists and engineers comprise only five per cent of the workforce.^{62,63}

Fundamental research can lead to important discoveries and scientific breakthroughs that over time can enable the development of new products and even entire industries. In Australia, the wireless LAN technology commercialised by CSIRO arose from radioastronomy research in the 1990s. Licensing the technology internationally has generated over A\$430 million in royalty income to Australia, and this would not have been possible were it not for the important role of government as a provider of patient capital to fund the underlying research.⁶⁴

Australian universities are proficient at licensing research outcomes to industry, having executed a total of 431 licence agreements in 2013. However, according to the latest National Survey of Research Commercialisation, only

22 university spinout companies were formed in 2013 (i.e. new companies based on intellectual property developed at the university), down from 47 in 2000, with only 159 spinouts having been formed in total since 2000.⁶⁵

Although the survey data is imperfect and likely excludes companies with less direct connections to universities, this rate of spinout formation equates to around one spinout company per Australian university every four years, which is a very low number given the university sector's annual research budget in STEM disciplines of A\$7 billion.⁶⁶

In contrast, the top 10 performing universities in the UK (where spinout creation is measured and rewarded under the Research Excellence Framework) created 21 spinout companies a year over the period 2010–2012, or an average of two spinouts per institution per annum.⁶⁷

It is important, however, not to confuse entrepreneurship with commercialisation of IP assets—as highlighted in Table 4.

Commercialisation can involve entrepreneurship where a new company is formed as the vehicle to take the technology to market, although as noted earlier most commercialisation activity in Australia centres on licensing of IP rights rather than spinout formation. A low rate of spinout formation means we are forfeiting much of the economic impact that could be gained from research.

Table 4: Differences between commercialisation of IP assets and entrepreneurship

Commercialisation	Entrepreneurship
Transactional—focuses on transferring IP rights in return for financial gain	Enabling—focuses on supporting new business creation
University's primary motivation is to generate additional revenue to the university by monetising an IP asset	University's primary motivation is broader economic growth by supporting the creation of new businesses
Focused on technological innovation as the basis for value creation	May be based on either technology or business model innovation
Focus on Publicly Funded Research Organisations (PFRO)-owned IP	Focus on idea regardless of IP ownership
Academic typically has limited ongoing involvement beyond transferring know-how and providing research capacity	Academic (or student) is typically the founder and heavily involved in the company going forward.

An overly narrow focus on commercialising research can also lead policymakers and university leaders to overlook the breadth of opportunity to build businesses that are based on the skills and capabilities of STEM graduates and students rather than on university research *per se*.

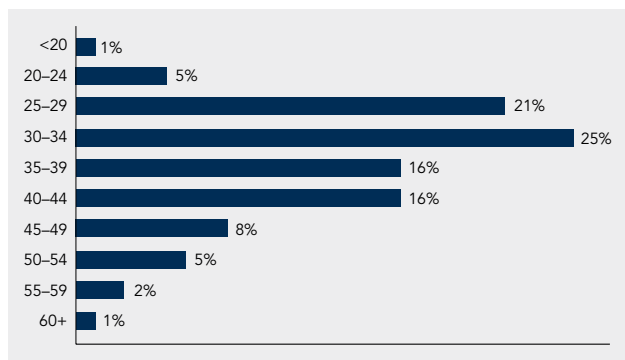
Some of the most valuable companies in the world are based on business model innovation, harnessing existing technologies (such as the internet) rather than developing new technology as the basis for their competitive advantage.

It is therefore important to temper any discussion of the economic impact from research with an acknowledgement that high-impact entrepreneurship can produce companies based on STEM skills as well as on publicly funded research.

A strong connection between university attendance and startup activity is already evident in Australia, albeit with a gap between graduation and first business creation.

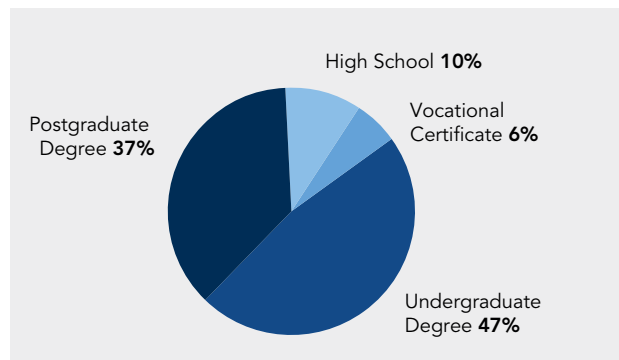
In 2014, 430 current Australian startup founders were surveyed for Startup Muster,⁶⁸ the largest survey of the Australian startup community. The survey found that 84 per cent of Australian startup founders have been to university, and the average age of startup founders is 36—suggesting that many startup founders choose to enter the workforce before founding a startup (Figures 5 and 6).

Figure 5: Age of Australian startup founders



Source: Startup Muster (used with permission)

Figure 6: Educational attainment of startup founders



Source: Startup Muster (used with permission)

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CHAPTER 3

ENTREPRENEURSHIP SKILLS



KEY POINTS

- ▶ Exposure to high-impact entrepreneurship during university has been shown to lead to greater levels of startup formation.
- ▶ Entrepreneurship skills can be taught.
- ▶ The skills needed for high-impact entrepreneurship are substantially different to those needed for small business entrepreneurship.
- ▶ The most effective entrepreneurship education combines classroom-based learning with experiential programs such as incubators, accelerators, internships and overseas placements.

THE “ENTREPRENEURS-ARE-BORN” MYTH

It is a common myth that individuals either “have what it takes” to be an entrepreneur, or they do not. Proponents of this view would argue that those people with the right make-up will find their way into entrepreneurship, while the rest of population should follow other career paths.

Fortunately, this approach does not reflect how individuals actually become entrepreneurs. There is evidence that exposing young people to entrepreneurship, and equipping them with practical skills, not just plants the idea of becoming an entrepreneur but also results in tangible increases in the level of high-impact entrepreneurship and creates significant economic impact.⁷⁰

Asking whether teaching practical entrepreneurship skills will make people more successful as entrepreneurs is rather like asking whether leadership training improves leadership skills and makes people better leaders. The answer is, of course, that practical skills and knowledge can be learned and applied in entrepreneurship just as in any other discipline, and this does increase the likelihood of success.⁶⁹

A cohort study of 836 students from the National University of Singapore have demonstrated that exposure to entrepreneurship leads to increased entrepreneurial interest and increased entrepreneurial behaviour, and that practical skills can be taught to improve the likelihood of an individual entrepreneur being successful.⁷⁰

The ecosystems whose entrepreneurs are most successful are also the ones in which entrepreneurial training is readily available—either as formal training or via peer-based learning.

WHAT FACTORS PRODUCE ENTREPRENEURS?

High-impact entrepreneurs are a product of multiple internal and external factors. Figure 7 and Table 5 illustrate the factors whose presence positively influences whether an individual becomes an entrepreneur. Although not all are required, the presence of most or all of these factors increases the likelihood that an individual will pursue an entrepreneurial pathway.

Figure 7: Factors that influence whether an individual becomes an entrepreneur



Table 5: Internal and external conditions that influence entrepreneurship decisions

Condition	Importance
Local cultural attitudes towards entrepreneurship	Countries in which high-impact entrepreneurship is celebrated tend to have a higher rate of high impact entrepreneurs.
Individual personality	Certain personality traits predispose an individual to high-impact entrepreneurship.
Role models	Successful young entrepreneurs act as role models and can influence career choices by providing young people with tangible evidence that people like them can succeed as entrepreneurs.
Exposure at school, university and in the family	Familiarity with the concept of startups helps to avoid common misconceptions.
Practical entrepreneurial skills	Acquiring practical skills through education and experience increases competence, reduces fear of failure and makes it easier to “just have a go”.
Supportiveness of local startup ecosystem	Individuals assess the prevailing ecosystem conditions and judge the supportiveness of the ecosystem before deciding whether or not to launch a startup.

THE ROLE OF INDIVIDUAL PERSONALITY

Not everyone is cut out to be an entrepreneur, especially a founder of a high-growth technology company.

It has been proposed that there are six core attributes that make some people more likely to succeed as an entrepreneur.^{71,72} They are:

- 1. Need for achievement:** Consistently sets high personal standards, actively seeks opportunities to execute ideas rather than just having ideas.
- 2. Self-confidence and internal locus of control:** Views oneself as capable and in control of situations; feels empowered to tackle difficult problems.
- 3. Need for autonomy:** Prefers to direct own work rather than work for others or in highly structured organisations.
- 4. Tolerance for ambiguity and risk:** Comfortable working in environments where the path to success is unknown and there is a high risk of failure. This often manifests in a greater preparedness to “burn the ships” by quitting a safe job in order to commit to a startup opportunity.
- 5. Creativity:** Well-developed creative thinking and problem-solving skills.
- 6. Conscientiousness:** Persistent even in the face of significant obstacles and willing to continue in challenging conditions in order to succeed.

Investors in startups also look for specific attributes in founders they are considering backing. According to Gary Visontay, General Partner of Sydney Seed Fund, founders who are most likely to succeed, and therefore are viewed favourably by investors, have the following four “EPIC” qualities:⁷³

- ▶ **Execution:** Consistently follows through on ideas and opportunities to completion, rather than having a large number of ideas floating around or working on many unfinished projects for extended period.
- ▶ **Perspective:** Has a realistic and flexible view of the business, the risks and the level of effort needed to succeed, has good intuition, and is willing to change direction based on customer feedback. Does not hold a naïve or narrow view of the ease of success and is not so wedded to the idea that they will pursue it despite evidence that change is needed.
- ▶ **Intellect:** Has the ability to learn new skills quickly and to become proficient at a wide range of tasks.
- ▶ **Communication:** Can articulate the company’s strategy clearly, succinctly and convincingly to employees, investors and customers.

ATTITUDES CAN BE SHAPED

According to Tina Seelig, Professor at the Stanford School of Engineering and director of the Stanford Technology Ventures Program, “entrepreneurship education empowers young people to see the world as opportunity rich.”⁷⁴

Stanford, like many other universities, has made a conscious choice to expose students to a wide range of career paths that includes becoming an entrepreneur and to provide them with sufficient practical training and support so if they choose to pursue startup opportunities they are well prepared for what lies ahead.

Significant research effort has gone into examining whether teaching entrepreneurship in universities leads to more entrepreneurs. Most of these studies have focused on small business entrepreneurship, but several have looked specifically at the effect of entrepreneurship education and exposure to the creation of high impact technology-based companies.

One of the largest such studies was conducted at the National University of Singapore (NUS)⁷⁵ and followed 836 NUS students from a wide range of disciplines who took part in (a) traditional classroom-based entrepreneurship education programs, and (b) experiential entrepreneurship programs such as incubators, business idea competitions, mentoring programs and startup internships.

The study examined the impact of the two types of entrepreneurial learning on the students’ entrepreneurial attitudes (i.e. how interested they are in starting a company in the future) and entrepreneurial actions (i.e. whether they actually took concrete steps toward launching a new venture).

The NUS study reached two important conclusions:

1. Participation in classroom-based entrepreneurship programs positively influences entrepreneurial attitudes, but not actions.
2. Participation in experiential entrepreneurship programs positively influences both entrepreneurial attitudes and actions.

A similar study by the Kauffman Foundation⁷⁶ in the US found that university students who took part in experiential entrepreneurship programs (such as an internship in a tech startup or a venture capital firm that invests in startups) in conjunction with classroom-based courses were three times more likely to be involved in the creation of a new venture than the rest of the student population.

These findings have three important implications for teaching entrepreneurship:

1. Classroom-based entrepreneurship education programs by themselves have little effect on rates of entrepreneurship.
2. Classroom-based programs are of course still important because they increase the knowledge and skills that students can put into practice if and when they actually start their own company, or as an employee in an existing company.
3. Experiential entrepreneurship education programs are vital if we want to produce more entrepreneurs. They provide an environment in which students can experience aspects of actually forming a startup in a relatively safe environment and with regular support and guidance.

Specifically, experiential programs help students to take concrete action by:

- ▶ Cementing learnings from classroom-based courses and providing context in which to apply the theory
- ▶ Allowing them to experiment with the idea of entrepreneurship as a career path
- ▶ Providing role models in the form of mentors and coaches
- ▶ Increasing confidence in their ability to succeed by allowing them to meet peers who are running successful startups
- ▶ Reducing their fear of failure by allowing them to fail fast in a safe environment
- ▶ Expanding their professional network via exposure to the entrepreneurial ecosystem outside the university.



Entrepreneurship must be enthusiastically encouraged and embraced. Kids need to know that starting and building a business can be a fun, rewarding life path. Education on how to become an entrepreneur has to start early at home and in school when kids first set up their roadside lemonade stand, and extend to university where they can actually experience many aspects of real entrepreneurship and high-growth company formation.

Bill Bartee
Partner, Blackbird Ventures

ENTREPRENEURIAL ATTITUDES DEVELOP EARLY

Although this report has a focus on the role of universities, it is important to reflect on the role that schools play in exposing young minds to the concept of entrepreneurship.

A Dutch study examined the effect of entrepreneurship education on primary school students' skills and attitudes. The study found a significant positive effect of early entrepreneurship education on skills such as persistence, creativity and pro-activity. This evaluation of primary school graduate performance suggests that early entrepreneurship education contributes significantly to developing such non-cognitive entrepreneurial skills.⁷⁷

A separate longitudinal study examining the effects of participation of youths in the Juvenile Achievement Young Enterprise (JA-YE) programs across Europe, found that by the age of 25, the alumni demonstrated a 15 per cent rate of startup formation. In comparison, the average rate of startup formation among the European population was 5–6 per cent.⁷⁸

Heightening the curiosity intrinsic to most children and exposing them to the basic principles of business creation in school is an effective way of stimulating their interest in entrepreneurship, developing a sense of initiative and developing a mindset of creating jobs rather than applying for them. This exposure also leads to a greater level of awareness and receptiveness to entrepreneurship programs during university years.

Best practice programs in schools encourage children to ask themselves “What do you want to create?” rather than “What do you want to be?”, and are more about opening their eyes to opportunities than about teaching complex subject matter.

WHAT SKILLS ARE NEEDED TO BE A SUCCESSFUL ENTREPRENEUR?

To be successful, startup teams must possess a range of skills spanning product development, sales, marketing, customer acquisition, capital raising, finance, law, leadership and team building.

The reality is that most startup founders do not have all of the required skills, and even when a high-quality team with diverse skill sets and backgrounds is assembled it is likely that there will be gaps in the capabilities of the team.

In 2014, Startup Muster surveyed 430 Australian startup founders and found that 58 per cent had not founded a startup before.⁷⁹ Given the relative immaturity of Australia's startup ecosystem and the large number of inexperienced entrepreneurs, it is important that educational programs focus on imparting core skills.

Experience with numerous incubator programs has shown that entrepreneurs often have a limited understanding of the fundamentals of launching and growing a business, and as a result mentors end up spending much of their time not mentoring, but teaching fundamental concepts to startup founders, which is highly inefficient.

A large number of courses have been developed in recent years to provide a solid practical grounding to startup founders and teams. A summary of some of the most commonly taught content is provided in Table 6 to illustrate the core skills required by high-impact entrepreneurs.

Table 6: Core skills required by high-impact entrepreneurs

Skill / topic	Importance
Business model innovation	<p>Developing a viable business model is an essential task in the early days of any startup in order to ensure that the business meets customer needs, can scale rapidly and can become profitable.</p> <p>Companies developing technology-based products and services are often also developing new and untested business models, and it is therefore essential that these entrepreneurs have a strong grounding in business model innovation.</p> <p>Tools such as the Business Model Canvas,⁸⁰ Lean Canvas⁸¹ and Validation Board⁸² are commonly used to guide entrepreneurs through the process of articulating, testing and validating hypotheses on which their business idea is based and to develop a business model that will enable the company to scale rapidly.</p>
Product development	<p>The Lean Startup approach to product development is important in any company that is developing new technology-based products. This approach centres on rapid iteration of the product based on customer feedback as a means of ensuring the product meets the needs of the target market.</p> <p>As noted by Ash Maurya in his book <i>Running Lean: Iterate from Plan A to a Plan That Works</i>, a large proportion of startups that fail do so because they build products that do not fully match the needs of their target market.⁸³</p>
Sales	<p>Startup founders require strong sales skills, not just to sell their product to customers, but also to sell equity in the business to investors in return for funding, and to prospective employees who typically accept a lower salary than they would receive in a larger company in return for a stake in the business.</p> <p>Many startup founders with technical backgrounds lack sales experience, and this is therefore a core skill that startup founders need to learn.</p>
Financial management	<p>Managing financial resources is a critical activity during rapid growth. Running out of cash is one of the most common causes of startup failure, and often stems from a lack of financial acumen in the early stages of growth, and before the company is large enough to have a dedicated CFO.</p> <p>Key skills needed by startup founders include understanding financial statements, managing cashflow, creating financial forecasts and reporting to shareholders.</p>
Legal management	<p>Founders of high-growth companies need to have an appreciation for a range of legal issues spanning topics such as employment law, capital raising, company directorship, solvency and competition law.</p> <p>Whilst startups can seek external legal advice, it is critical that founders have a sufficient grasp of the issues to know when they need advice, and also to ensure they are not being over-advised.</p> <p>For some companies, regulatory issues are also critical—for example in biotech, medical devices, aerospace, aviation and providers of financial products and services.</p>
Intellectual property management	<p>Protection and enforcement of IP rights is an important theme for many technology-based companies. Avoiding infringement of IP rights owned by others is also an important topic.</p> <p>Startup founders need to have a broad awareness of IP management concepts in order to maximise the strategic value of the IP assets owned by the company and minimise the risk of litigation by larger competitors.</p>

Skill / topic	Importance
Platform economics	<p>A growing number of companies are engaging in platform-based business models in which they do not sell a product or service, but instead provide a platform on which others can create and exchange value via provision of products and services.</p> <p>Platform-based businesses are generally engaging in two or more sided markets, and are common among internet businesses spanning a wide range of industries.</p> <p>In his book <i>Platform Scale: How an emerging business model helps startups build large empires with minimum investment</i>, Sangeet Paul Choudary discusses the importance of understanding the economic principles of platforms and notes that many startups fail due to a lack of understanding of these principles.⁸⁴ Teaching platform economics to startup founders is therefore an important step in preparing them for launching platform-based businesses.</p>
Capital raising	<p>Most high-growth companies need to raise external capital from investors such as angel investors or venture capital funds to fuel their growth. The process of raising capital is complex and requires an understanding of how different types of investors work, as well as a grasp of concepts such as portfolio theory, capitalisation tables and dilution, and an understanding of the financial and legal terminology involved in financing.</p> <p>A recent US study by Professor Tom Eisenmann of Harvard Business School analysed the funding rounds of 200 startups that had collectively raised A\$500 million from investors.⁸⁵ The study found that the average seed funding round involves contact with 58 investors, 40 investor presentations and takes an average of 12.5 weeks to raise an average of A\$1.8 million. It also found that many startup founders make common mistakes in pitching to investors, and that they could significantly improve the efficiency and success rate of fundraising by acquiring a better understanding of the process.</p> <p>The same challenges exist in Australia, but with the added drawback that there are fewer investors and a less sophisticated funding environment.</p> <p>STEM students (and indeed most business students) are not exposed to these concepts, and as a result many fail to raise capital and those that do find that it takes longer than it should, restricting the growth potential of their business.</p>
Employee Share Ownership Plans (ESOPs)	<p>ESOPs are an important mechanism by which startup founders incentivise and reward employees. The scope to use ESOPs in Australia has been greatly improved as a result of the government's recent changes to the tax treatment of options. However, the use of ESOPs remains a relatively complex area and one that startup founders need to understand.</p>
Building and managing teams	<p>High-growth companies often need to recruit large numbers of staff in short periods of time to maintain their rate of growth. By way of example, in mid-2013 Atlassian announced plans to recruit 100 product development staff in a three-month period.⁸⁶ Similarly, Cochlear added an average of 175 new staff per year over an eight-year period to 2012.⁸⁷</p> <p>During the early stages of growth, startup founders need to have strong skills in recruitment, selection, management and leadership of rapidly growing teams. These skills are rarely taught to students in STEM disciplines.</p>
Managing rapid international growth	<p>A feature of most high-growth companies in any sector is that they are competing in international markets. The ability to manage rapid international growth requires an understanding of market dynamics, pricing strategies, foreign exchange, international legal and regulatory issues, cultural differences and operational matters associated with establishing a presence in overseas locations.</p> <p>Immersion programs such as Startup Catalyst⁸⁸ are a valuable means of exposing students to overseas markets and allowing them to gain a first-hand appreciation of how those markets work.</p>



As an active investor in Australian startups I consistently see skills gaps in the startup founders I meet with. The most common gaps are a lack of financial acumen, lack of understanding of how to build and manage teams, and a limited understanding of how to rapidly scale a company beyond an initial concept. I strongly believe that universities have an important role in equipping graduates with these sorts of skills, and doing so across all disciplines including STEM. An investment in building these skills in graduates would lead to many more investable startups and make a large contribution to the growth of the Australian technology sector.

Garry Visontay
General Partner, Sydney Seed Fund

Many of the topics in Table 6 are of little relevance to small business entrepreneurs as their companies (by definition) do not experience rapid growth or grow via external investment. Conversely, many general business courses that might be of value to small business owners would be of limited value to high impact entrepreneurs.

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CHAPTER 4

**BEST PRACTICE
ENTREPRENEURSHIP
EDUCATION**

KEY POINTS

- ▶ Best practice entrepreneurship education makes a clear distinction between high-impact entrepreneurship and other types of entrepreneurship.
- ▶ Experiential programs such as incubators and internships are more effective in encouraging students to take steps toward starting their own businesses.
- ▶ Teaching entrepreneurship requires the active involvement of experienced entrepreneurs and active connections to the local startup ecosystem.
- ▶ Producing technology companies requires teaching entrepreneurship skills to STEM students.
- ▶ A staged, opt-in approach to engaging students is more effective than providing a single mandatory course.
- ▶ The “Lean Startup” approach involves rapidly testing and refining business ideas, and is more effective than having students write business plans which usually prove to be exercises in creative writing.
- ▶ The Lean LaunchPad course is becoming recognised as the international gold standard in entrepreneurship education, and is based on Lean Startup principles.
- ▶ Visible support of university leadership is essential to achieving impact.

THE IMPORTANCE OF UNIVERSITIES

Universities have a central role in producing and training entrepreneurs. Those that are effective in this endeavour generally set out to achieve the following outcomes:

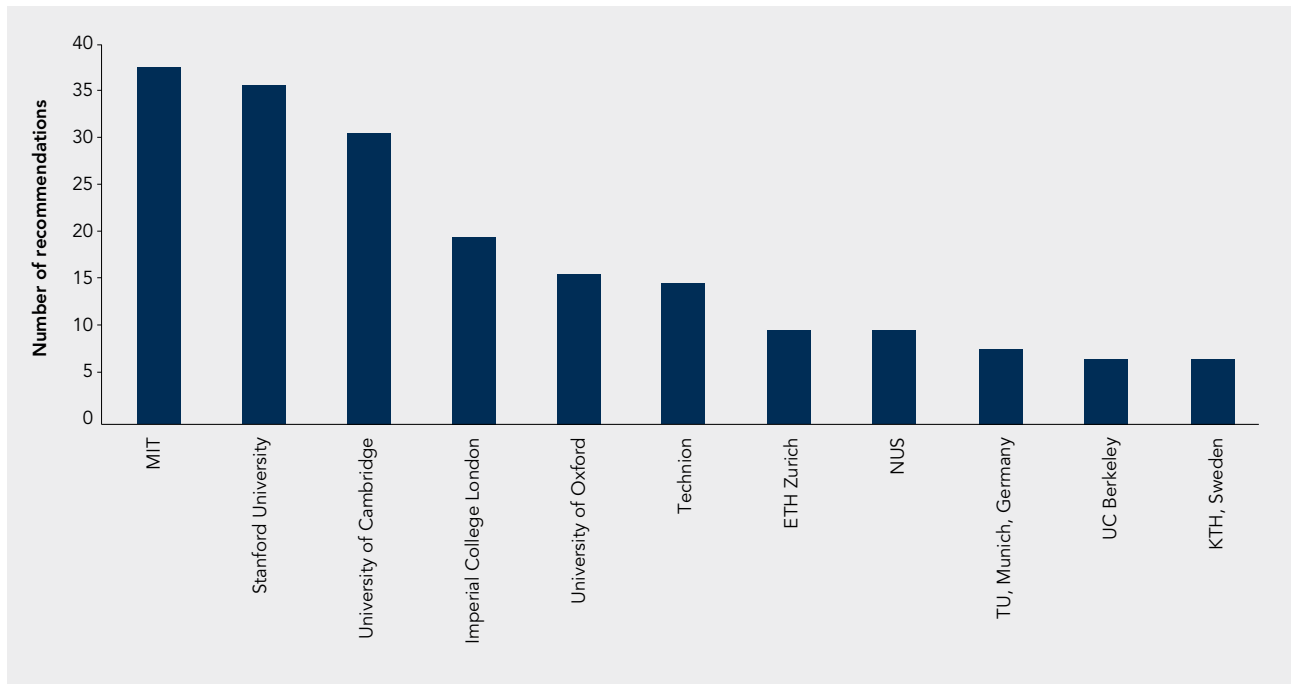
- ▶ Develop an entrepreneurial culture that changes the “traditional” attitudes of university academics, students and graduates
- ▶ Impart practical skills that budding entrepreneurs can put into practice
- ▶ Expand professional networks
- ▶ Facilitate access to important resources such as funding and experienced mentors.

In Chapter 2 we considered which countries have made significant investments in boosting innovation and high impact entrepreneurship as drivers of economic growth, and the common themes among them. In this chapter we will consider which universities represent best practice in their efforts to produce entrepreneurs, and review the approaches they have in common.

The MIT Skoltech survey, conducted in 2012, ranked universities from around the world based on their impact in creating and supporting an ecosystem for entrepreneurship and innovation. It was produced from a survey of 61 international experts and practitioners.

The results of the survey show several familiar universities as highly ranked (Figure 8).⁸⁹ Several of these universities are profiled in this chapter, and the reasons for their inclusion are discussed as a means of highlighting some common themes.

Figure 8: Universities ranked by international expert by impact on creating and supporting technology innovation ecosystems (2012)



Similar observations can be made from Figure 3, which shows that many of the universities in the MIT Skoltech study are indeed the ones that have produced the most startup founders.

WHAT DOES BEST PRACTICE LOOK LIKE?

Entrepreneurship education has matured greatly over the last decade, and there has been a good deal written about what works and what does not.

This section summarises some of the key learnings from entrepreneurship education programs in universities around the world, and provides a simple set of guidelines that can be followed by any university seeking to stimulate entrepreneurial thinking and behaviours among students, and to equip them with practical entrepreneurship skills.

Recent books such as *Entrepreneurship Programs and the Modern University*,⁹⁰ *Teaching Entrepreneurship: A Practice-Based Approach*⁹¹ and *The Innovative and Entrepreneurial University*⁹² are valuable resources for greater detail on specific programs, and have been drawn upon in formulating the findings in this report.

CLEAR FOCUS ON HIGH GROWTH

High-growth companies are “born global”, generally serving large global markets, as opposed to smaller domestic markets which are typically served by small businesses that grow at a much slower pace. They are also very different from small businesses and social ventures, and notwithstanding that there are many valid reasons to teach small business entrepreneurship or social entrepreneurship, it is essential that courses make a clear distinction between the different types and set out to teach concepts that are appropriately tailored.

ENTREPRENEUR PROFILE—ELLIOT SMITH



Elliot is a co-founder of HSK Instruments, a startup company developing respiratory physiotherapy products to assist sufferers of respiratory conditions such as cystic fibrosis. Elliot studied Electrical Engineering at The University of Queensland and is currently completing a PhD relating to design of magnetic resonance imaging (MRI) scanners.

Elliot chose engineering because he enjoyed making things and felt he could make an impact on society. During his studies he worked on several “pet projects”, but never believed any of his work could be the basis for a startup company. In 2012, Elliot presented his work on respiratory physiotherapy as part of a research showcase event, for which he won a prize of entry into the university’s startup incubator, ilab.

Over a six-month period in the incubator, Elliot took part in short courses on Lean Startup principles, capital raising and investor pitching, and was given regular mentoring and coaching from experienced local, interstate and international entrepreneurs.

Along with his co-founders (also engineering students) Elliot made the decision to form a company, HSK Instruments, to complete development of the technology and launch a product—now named Pepster. This medical device will be launched this year in Australia, after which the company intends launching internationally.

HSK was selected to present at the Tech23 national startup pitching event in 2013 where it won the Most Investable Award, and also at the Hill’s Young Innovator of the Year where HSK was awarded Overall Winner at the iAwards in 2014.

Following this recognition, Elliot was selected to take part in the inaugural Startup Catalyst program, which took twenty STEM students and recent graduates to San Francisco and Silicon Valley for a fully funded ten-day startup immersion trip.

According to Elliot, the exposure he had to startups and high-impact entrepreneurship through the ilab incubator and the Startup Catalyst program had a profound effect on his attitudes toward startups. It has convinced him that a PhD does not only qualify him to pursue a career in research, but is also a valuable grounding for starting high-growth technology companies—a career path which he is determined to pursue.

Despite having had a positive exposure to high-impact entrepreneurship during university, Elliot recognises that his experience is rare in Australia, particularly among postgraduate STEM students. He notes that “Universities need to be vocal in their support of startups. The same way that the best research is plastered on billboards, we should be showing the public that our universities train people not only to work in industry but to help expand it with businesses of their own.”

LEAN STARTUP—THE GOLD STANDARD FOR ENTREPRENEUR EDUCATION

The Lean Startup approach is based on the notion of *evidence-based entrepreneurship*. It sets out to quickly test and validate assumptions behind a startup idea based on interactions with customers, rather than putting students through the process of writing a business plan based on the assumption that they can derive a valid business model *a priori*.

The businesses that benefit most from the Lean Startup course are those that are engaging in business model innovation, often in conjunction with technology innovation. They are developing businesses that are not replicas of existing companies, but are pioneering a new way of doing things as they bring new technologies to market.

The principles behind the Lean Startup approach were the subject of an article by Steve Blank in the Harvard Business Review in 2013,⁹³ and many international universities have now embraced Lean Startup principles as best practice in all of their entrepreneurship programs.

The Lean LaunchPad course, developed by Steve Blank and Jerome Engel at Stanford University and UC Berkeley in 2010, is based on Lean Startup principles and is becoming accepted as the gold standard in entrepreneurship education. It is a highly experiential 10–12 week program that takes students in any discipline through the entire process of developing, validating and implementing ideas for technology-based startups.

During the course, students work in teams to refine and test their business model hypotheses by engaging with potential customers, and in parallel are guided through a structured format that exposes them to the basics of developing a business model for a high-growth company.

The Lean LaunchPad does not encourage teams to start trying to build a business until they can articulate, test and validate (or invalidate) their hypotheses. Throughout the course teams often modify their business model many times as they improve their understanding of the customer's needs and the market dynamics, after which they can decide whether they have arrived at a viable and scalable business model that warrants launching a company. This approach helps teams to identify early on if their opportunity is not commercially viable and allows for fast failure. Only once a viable business model is developed are the teams encouraged to start working on operational plans, financial models etc.

The Lean LaunchPad culminates in a "Demo Day" in which teams present their business models and summarise their learnings to an audience of investors and successful entrepreneurs, many of whom will be able to help the companies to develop further. Even teams that fail to discover a viable business model are invited to present their learnings for the benefit of other participants.

The Lean LaunchPad is run as a "flipped classroom" in which the students read materials or watch video lectures in their own time, and class time is used mainly for discussion, mentoring and presentation of learnings by the teams.

The Lean LaunchPad has been successfully tailored for a number of specific disciplines such as biotech, cleantech, medical devices and therapeutics. This enables teams to learn about relevant industry-specific issues and allows the program to engage instructors who have deep domain knowledge and can therefore be a useful guide to the teams.

Over the last five years the Lean LaunchPad has been delivered at almost every major university in the United States, and is being adopted by universities and research institutes around the world due to its combination of quality content and highly experiential nature.

The US government is also using the Lean LaunchPad to infuse universities and publicly funded research organisations with an entrepreneurial mindset and provide them with practical skills. The course is delivered through the National Science Foundation Innovation Corps, which in four years has trained over 1,500 academics and students in STEM disciplines and is now expanding into the National Institute of Health, the Department of Energy and other federal agencies.⁹⁴



As a leader in entrepreneurship education for the last 25 years, I can attest that the Lean LaunchPad approach has totally revolutionized the field. In five years since its initial introduction by Steve Blank at Berkeley and Stanford it has become the gold standard in higher education and in practice as well. Adopted in the US by every major university, adopted by the National Science Foundation (and many other agencies), and being implemented by venture capitalists and major corporations, Lean LaunchPad has changed the vocabulary and practice of innovation across the USA and increasingly across the world.

Jerome Engel

Founding Executive Director and Senior Fellow, Lester Center for Entrepreneurship, University of California at Berkeley; National Faculty Director, National Science Foundation Innovation Corps

EXPERIENTIAL

One of the key learnings from university programs has been that entrepreneurship education should mostly not be about traditional classroom-based education. It should focus on giving students opportunities to experience entrepreneurship for themselves.

As noted earlier, experiential programs have been found to positively influence both entrepreneurial attitudes and actions, and lead to students taking concrete steps toward starting their own ventures. Therefore, if a university’s objectives include producing more entrepreneurs, experiential programs are vital. Table 7 shows some of the key experiential programs and their characteristics.

Table 7: Characteristics of experiential programs of universities that have a high-impact entrepreneurial culture

What	Why
Student clubs	Students learn effectively from each other and often invite experienced entrepreneurs from the external startup community to get involved.
Student startup incubators and accelerators	Coaching and mentoring is provided by experienced entrepreneurs. Funding allows students to work intensively on their startup idea instead of working part-time to support themselves.
Seed funds	Funding to enable students to launch startups and validate their ideas quickly. Generally best combined with an incubator or accelerator program to ensure the startups receive expert guidance.
Internships	Opportunity to see first-hand what it’s like inside a high-growth startup and work on various aspects of the business.
Startup stalls at career days	Meet with other young entrepreneurs and find out what startups are all about.
Business idea competitions	Give students a sense of what it is really like to develop and validate an idea with real customers, and pitch it to investors.
Hackathons and Startup Weekends	Intensive exposure to startup concepts via creation, validation, prototyping and pitching an idea over the course of 2–3 days.
Overseas immersion programs	Exposure to different and usually more mature startup ecosystems can “infect” students with a passion for replicating the best parts of the ecosystem they have visited.
Visits to major startup events	Brief immersion in the local, interstate or overseas startup scene builds professional networks and practical knowledge, and provides an opportunity to road-test startup ideas with peers.
Entrepreneurs-in-Residence	Embedding experienced entrepreneurs in universities provides students with opportunities for informal mentoring and for the EIR to get involved in multiple aspects of university entrepreneurial life.

CASE STUDY: UNIVERSITY OF CAMBRIDGE, UK

The Cambridge area is widely recognised as a hub for high-tech entrepreneurial activity. It is home to around 1,500 technology companies spanning many science and technology disciplines, and over the last two decades high impact entrepreneurship has become integrated into the local culture.

The Centre for Entrepreneurial Learning (CfEL) is the primary entrepreneurship initiative at the University of Cambridge.^{95, 96} It was originally part of the Cambridge Entrepreneurship Centre (established in 1999), and since 2003 has been part of Judge Business School. It is supported by funding of A\$650,000 per annum from the British government through the Higher Education Innovation Fund. A further A\$2.2 million per annum is received from the university and external sources such as sponsors and donors.

CfEL has a stated aim of spreading the spirit of entrepreneurship within all discipline areas at UC and the wider community, and evangelizing and promoting high impact entrepreneurship based on science and technology. Most of the entrepreneurship education delivered by CfEL is hands-on, extra-curricular and non-accredited, and although the centre does deliver two curricular courses, these only teach around 90 students per annum. In contrast, its experiential programs engage thousands of students every year, mainly through practitioner-led programs using a “learning journey” approach in which students learn by doing and self-select into various programs based on their own interest.

The main experiential programs delivered by CfEL are:

Enterprise Tuesday—A series of free lectures to introduce students and staff to the world of entrepreneurship, as well as to encourage and inspire them to pursue their own entrepreneurial ambitions. Events are targeted at students and staff who are curious about entrepreneurship and who wonder whether entrepreneurship might be of interest to them. Enterprise Tuesday has run since 1999 and now engages around 1,700 students and staff per annum.

Enterprisers—A four-day residential program that guides participants in generating scalable business ideas from their research, with a focus on the health sector. So far Enterprisers has engaged 1,400 students.

EnterpriseWISE—An experiential education program for female entrepreneurs in science and technology. Participants undertake several lectures as well as working on group projects which they present to their peers and invited mentors the end of the program.

Ignite—An intensive extra-curricular one-week course for postdoctoral students interested in establishing a startup company to commercialise their research. The program helps students to generate business ideas based on their research and to develop them into real startups with the help of experienced entrepreneur mentors. It culminates in an investor pitching event and has supported over 700 participants since it started in 1999.

Accelerate Cambridge—A three-month accelerator program that combines entrepreneurship training, coaching and mentoring, and access to a shared workspace. The program accepts teams of two or more as long as at least one member is a Cambridge student, alumnus, or staff member. The program culminates in an investor pitching event.

Business Creation Competition—A competition run by the Cambridge University Entrepreneurs student association. Since establishment in 1999 it has awarded over A\$1 million in prize money to more than 40 startups formed by Cambridge students and staff.

WHAT ARE THE OUTCOMES?

The University of Cambridge has had an important role in growing the entrepreneurial ecosystem in and around Cambridge. Of the 1,500 high-tech companies in the area, approximately one third were formed as a direct result of University of Cambridge’s entrepreneurship initiatives. Companies formed by Cambridge alumni have raised more than A\$430 million in external funding and created approximately 4,300 jobs.

CfEL currently engages around 2,000 students a year across its various entrepreneurship initiatives, and since 2003 it has run over 200 programs and events which together have engaged over 16,000 people from the Cambridge community.

ENTREPRENEUR PROFILE: MARITA CHENG



Marita Cheng is the Founder and CEO of 2Mar Robotics. As a teenager, Marita had a keen interest in building things. When she studied Engineering and Computer Science at the University of Melbourne she developed a passion for robotics and mechatronics, and whilst a student founded Robogals, a volunteer-led organisation that aims to get girls interested in engineering and technology careers and tertiary studies. Marita was named 2012 Young Australian of the Year for her work on Robogals.

During university, Marita worked on using robotics to assist people with limited upper limb mobility, and in her final year of university Marita started 2Mar Robotics as a vehicle to make some of her robotics ideas a commercial reality.

Five weeks after forming 2Mar the company was accepted into the University of Melbourne's Melbourne Accelerator Program (MAP) which provided A\$20,000 in funding and access to a range of experienced mentors during a 12 week program.

After completion of MAP, 2Mar was awarded the Innovation Excellence Award from Tech23, Australia's most prestigious investor pitching competition for startups, and exhibited at CES 2014, the largest consumer electronics show in the world, with 140,000 participants in Las Vegas, where VentureBeat named Marita "the coolest girl at CES 2014".

Marita continues to serve on the board of Robogals Global (which has now delivered robotics workshops to 35,000 girls in nine countries), the Foundation for Young Australians, and RMIT's New Enterprise Investment Fund, where she helps decide on startup investments.

Marita attributes her passion for entrepreneurship to the exposure she gained through her university years including by taking part in the Melbourne Accelerator Program. According to Marita, "There is no age limit to being an entrepreneur. The earlier we expose students to the fun and excitement of entrepreneurship, the more entrepreneurs we will have in Australia. Australia is a nation that is talented at making things. We need to get better at getting out there and marketing and selling what we make. If we give STEM students the tools to sell, market and create companies from their products, we will be creating a strong cycle of innovation and technology for our country for years to come."

REACH

For student entrepreneurship programs to have a significant impact on the culture of the student population, or on attitudes toward entrepreneurship, it is essential that they engage a large number of students.

The universities with the most impactful entrepreneurship programs reach thousands of students, and over time entrepreneurship becomes woven into the fabric of the university so that almost all students have at least a basic awareness of the various entrepreneurship initiatives of the university.

Effective ways of maximising reach include hosting a large number of events that are open to the entire university community across all disciplines, holding business idea competitions with cash prizes, and having programs such as entrepreneurship centres that operate continuously rather than in discrete blocks of time.

One effective way of achieving scale and significant reach is to place responsibility for student entrepreneurship in a dedicated centre within the university that has central funding and support and does not restrict its offerings to students in one faculty. Examples of this approach include the Centre for Entrepreneurial Learning at the University of Cambridge, the Martin Trust Center for MIT Entrepreneurship and the Bronica Entrepreneurship Centre at Technion.

CASE STUDY—MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT), USA

MIT teaches a total of 48 separate entrepreneurship courses to undergraduate and postgraduate students and staff, spanning many different disciplines and ranging from short courses to complete masters degrees. Entrepreneurship courses are taught in MIT's five schools—the School of Engineering, the School of Science, Sloan School of Management, the School of Architecture and Planning, and the School of Humanities, Arts and Social Science. MIT also delivers the "Entrepreneurship 101" MOOC which is now available to students around the world.

Students at MIT can take part in over 20 student entrepreneurship clubs that cater for different interests (tech, non-tech, social ventures etc.) and different cultural backgrounds.

The MIT Technology Licensing Office supports access to IP by startups formed by staff or students, with the aim of making it relatively simple for staff or students to obtain IP rights to technologies they have developed and use them as the basis for a new company.

The university has a number of dedicated seed funding programs that provide early-stage funding for promising student projects that could become startups.

The university also actively engages external entrepreneurs as mentors and runs many events, conferences and startup idea competitions to connect students with the external startup ecosystem so that they have strong networks to help them grow their startups once they leave the university.

The Martin Trust Center for MIT Entrepreneurship acts as a core part of MIT's entrepreneurship ecosystem and supports student startups via provision of a collaborative workspace, meeting rooms, a videoconference system and a makerspace. It also has a small group of full-time entrepreneurs in residence who advise students, a business idea competition with a A\$100 000 prize and the MIT Global Founders' Skills Accelerator (MIT GFSA), one of the top-rated university student startup accelerators in the world.

WHAT ARE THE OUTCOMES?

MIT estimates⁹⁷ that at the end of 2006, there were 25,600 active companies founded by MIT alumni, employing 3.3 million people and generating annual world revenues of nearly A\$2.8 trillion. This group of companies, if its own nation, would be the 11th largest economy in the world.

Surveys of MIT graduates have found that approximately 30 per cent of international graduates and 20 per cent of domestic graduates go on to form a startup, with between 900 and 1,000 companies started by MIT alumni and students every year.

MIT has found that 41 per cent of startup founders who studied at MIT are serial entrepreneurs, having started multiple companies, and the average age of first-time startup founder from MIT is 28—suggesting that a large proportion of MIT students who start companies do so shortly after graduation rather than building their careers first.

ENGAGING EXPERIENCED ENTREPRENEURS

It is vital that the content of entrepreneurship education programs is current and relevant. One way this can be achieved is by engaging experienced entrepreneurs, investors and others with first-hand experience in high-impact entrepreneurship to augment academic teaching staff in delivery of student entrepreneurship programs. Successful entrepreneurs can also provide students with inspiration as role models.

The positive impact of having entrepreneurship courses taught by entrepreneurs and others with first-hand experience includes:

- ▶ Courses tend to be rich in actionable, practical content
- ▶ Students are inspired to take action and explore entrepreneurship for themselves
- ▶ Subjects focus on recent case studies and modern approaches
- ▶ Courses focus on high-growth businesses rather than attempting to cover a gamut of topics more relevant to small businesses entrepreneurship and social ventures
- ▶ Courses expose students to the startup community outside the university, and ensure that the right people are invited to be guest lecturers.

Maintaining the involvement of academic staff in courses is vital as it ensures rigour and quality in the teaching and assessment.

Engagement of external entrepreneurs can take many forms, including:

- ▶ Single lectures
- ▶ Adjunct lecturing positions across an entire subject
- ▶ Creation of course content or reviewing/providing advice on course content
- ▶ Mentoring in incubators, accelerators, Startup Weekends
- ▶ Judging at ideas competitions.

Notable examples of Australian universities engaging experienced entrepreneurs include:

- ▶ The iAccelerate Centre at the University of Wollongong invites Jerome Engel (a leading entrepreneurship educator and Executive Director of the Lester Center for Entrepreneurship, University of California at Berkeley) as an annual guest speaker and mentor
- ▶ Steve Wozniak (Co-founder of Apple) is an Adjunct Professor at the UTS Faculty of Engineering and IT and provides mentoring to students startups.

A note of caution: Busy entrepreneurs should be used selectively and where they can add most value. Several Australian universities have engaged successful entrepreneurs to teach entrepreneurship courses but have damaged relationships with those entrepreneurs by not providing adequate teaching support, not ensuring that enough students attend lectures, or by allowing students to enrol who have little interest in the topic.

CASE STUDY: STANFORD UNIVERSITY, USA

Stanford's student entrepreneurship programs are characterised by the depth and breadth of engagement between the university and experienced entrepreneurs from the external startup ecosystem, with boundaries often becoming blurred. For example, the Stanford Technology Ventures Program delivers a wide range of startup courses and extra-curricular activities for students in the School of Engineering, including the Lean LaunchPad course. It has a core team of six full-time teaching staff, all of whom have deep first-hand experience as entrepreneurs, 30 part-time or adjunct teaching staff (all with entrepreneurial experience) and a board of advisors that includes some of Silicon Valley's most successful entrepreneurs and investors.

Stanford also runs the Entrepreneurial Thought Leaders weekly lecture series in which the university invites successful entrepreneurs back to the university to share their experience with students and staff. The Entrepreneurship Corner (e-Corner) has evolved as an online collection of 3,000 free videos and podcasts featuring these entrepreneurship thought leaders. At Stanford, many academic staff are actively engaged in entrepreneurship and/or investing in startups, and are often the first source of commercial advice to their students as they help steer students toward commercially viable business ideas.

By augmenting academic staff with successful alumni entrepreneurs as external lecturers, Stanford helps to perpetuate a virtuous cycle in which alumni support each other and help to generate future waves of high-impact entrepreneurs. Importantly, the process of selecting, inviting and managing external guest lecturers and mentors is supported by a university-funded team to ensure academic staff are not burdened with these tasks.

In addition to education and mentoring, Stanford hosts many startup conferences and investor events during the academic year, places students as interns in local tech companies and supports multiple student-run entrepreneurs clubs and business idea competitions.

Stanford launched the StartX student accelerator in 2009 as a means of supporting student startups while the students completed their degrees. The university provides A\$1.7 million per annum to support its operations, and has raised a number of seed funds that invest directly in student startups.

WHAT ARE THE OUTCOMES?

Staff and alumni of Stanford have founded 40,000 companies that have created 5.4 million jobs and generate annual revenues of A\$3.8 trillion. Between 2007 and 2011, Stanford graduate entrepreneurs raised A\$5.8 billion in venture capital and angel investment.⁹⁸

Since StartX began in 2009, over 500 students have launched startups whilst studying at Stanford, and 85 per cent of these have attracted angel or venture capital funding, together raising over A\$985 million.

MULTI-DISCIPLINARY AND INCLUSIVE

Entrepreneurship programs should engage students from a wide range of disciplines to ensure that the program does not become siloed within any faculty or school, and to allow the students to benefit from diverse inputs and skill sets.

Where students are pursuing startup ideas (such as in Startup Weekends, incubators, accelerators and idea competitions) it is critical that they be encouraged to work in teams that have a range of disciplines and personality types.

This approach helps to avoid situations where a homogenous group of students work on a project but only have part of the required skill set to execute—such as when business school students come up with ideas for tech startups but have no ability to build even a basic prototype.

Student entrepreneurship programs also have an important role to play in encouraging more women to pursue entrepreneurial career paths. It is known that women are under-represented in high-growth startups in Australia, with various estimates placing female participation as startup founders between 6 and 19 per cent.^{99,100}

Programs such as iAccelerate at the University of Wollongong have sought to engage more women in entrepreneurship by making a public commitment to achieving gender balance, and ensuring that commitment is met.



iAccelerate has achieved a significant milestone in gender equity—nearly half our current startups have at least one female co-founder. Gender equity is embedded in our mission statement—but we saw real change once we took specific actions. We discovered after four years of trying, that it takes various ways to engage women, that it's one thing to state your mission, it's another thing to go well out of your way to get women involved. At iAccelerate we have created a community of women interested in entrepreneurship and support them at all the stages of their formation, from student formation onwards. We do many different things (host kids' E-Club, have a female investment strategy, have gender balanced pitching panels and women and men speakers at our events) but the most effective thing we have done is to launch a women's entrepreneurial breakfast series. The breakfasts produced immediate effect. The intake after the first breakfast saw 30 per cent female applicants and 50 per cent accepted companies had female founders. At the time of this writing 16 of the 34 startups currently in the iAccelerate program have a female co-founder.

Elizabeth Eastland
CEO, iAccelerate

MULTI-POINT ENGAGEMENT

A staged, opt-in approach to engaging students in entrepreneurship training is desirable so that individuals become more involved of their own volition rather than being forced to undertake mandatory courses.

This approach can be thought of as a funnel in which as many students as possible are exposed to small bites of entrepreneurship content via guest lectures, stalls at careers days etc. (Figure 9). Those students with the interest to progress further through the funnel will self-select and take on more substantial courses and/or get involved in hands-on programs such as incubators, accelerators and overseas placements.

According to the Kauffman Foundation (a US-based organisation focused on teaching, supporting and researching entrepreneurship), universities should provide students with opportunities to engage at “teachable moments” (such as when they have developed an interest in entrepreneurship and are considering forming their own startup) rather than attempt to indoctrinate students *en masse* regardless of their level of interest.^{101,102}

Multiple points of engagement also help to get entrepreneurship “into the air and the water” of the university.

Universities should aim to have as many students as possible exposed to entrepreneurship in the first one or two segments of the funnel, not only because this will increase the number that progress all the way through to actually launching startups, but also because the skills they will acquire will be valuable in any career path they choose, including working in established companies.

In practice, it is possible for universities to expose close to 100 per cent of students to entrepreneurship by ensuring that basic concepts are delivered in the form of guest lectures and events that engage the student population.

One of the best examples of opt-in, multi-point engagement is the range of student entrepreneurship programs delivered by the University of Cambridge through the Centre for Entrepreneurial Learning (Figure 10). The CfEL utilises an *Entrepreneurship Journey Map*, through which students self-select into entrepreneurship programs and courses spanning a continuum from inspiration (raising entrepreneurial awareness via guest lectures and networking events) through to implementation and company growth.¹⁰³

Figure 9: Opt-in funnel approach to student participation in entrepreneurship programs

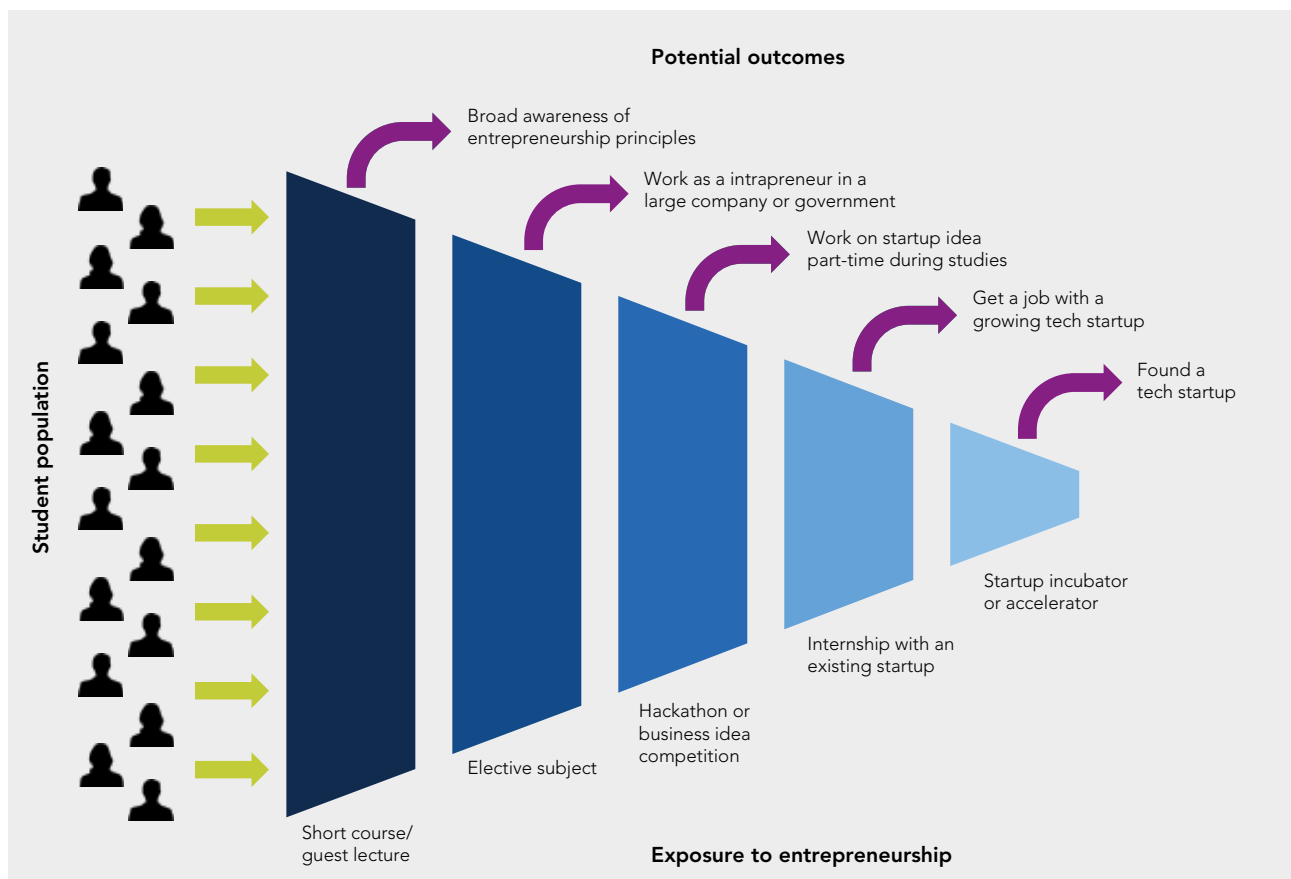
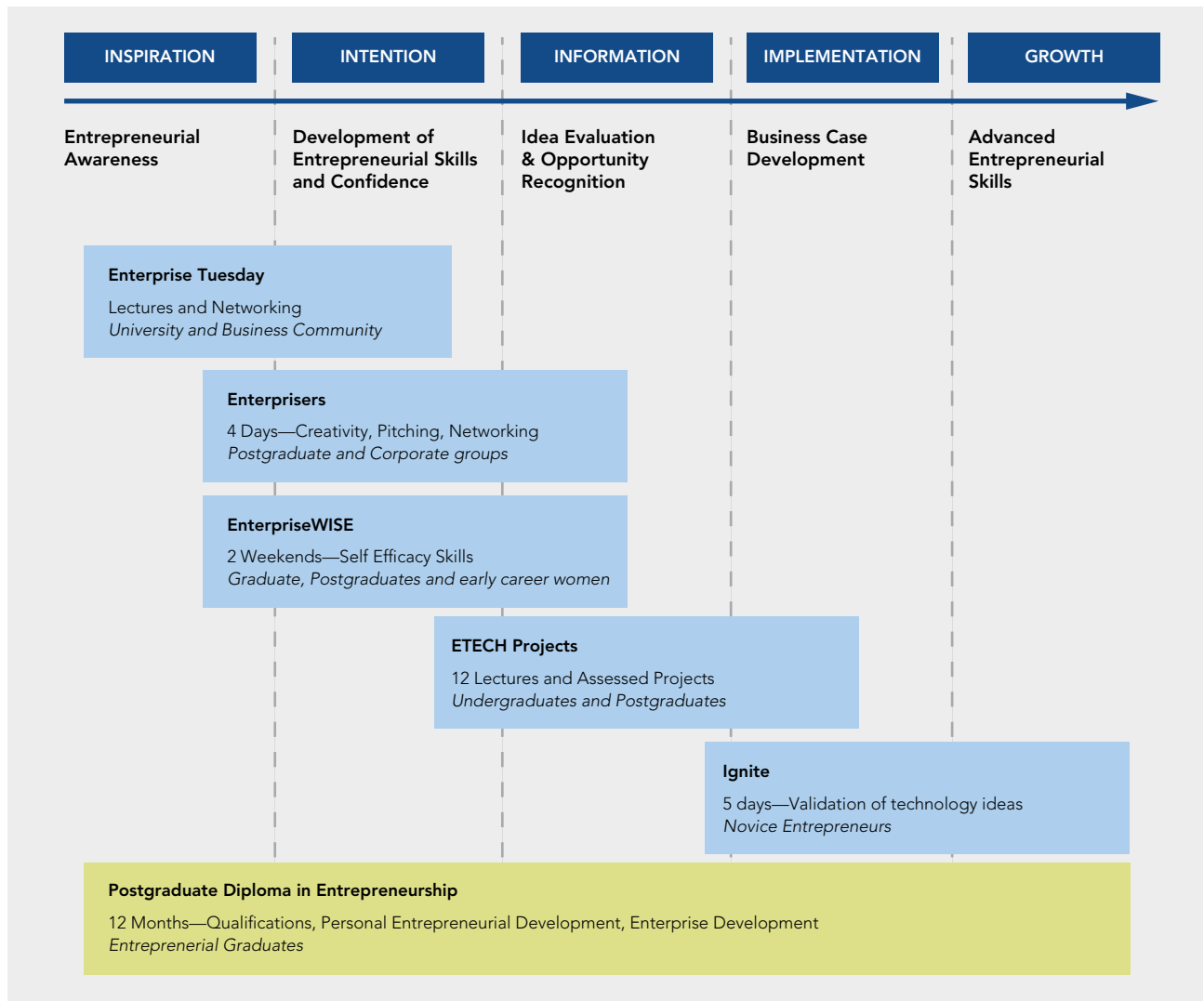


Figure 10: The University of Cambridge *Entrepreneurship Journey Map*



CASE STUDY: TECHNION—ISRAEL INSTITUTE OF TECHNOLOGY

Technion¹⁰⁴ is recognised as Israel's premier science, technology and engineering university, having produced over 95,000 graduates in technical disciplines since 1927.

A core part of Technion's entrepreneurship ecosystem is the Bronica Entrepreneurship Centre,¹⁰⁵ which acts as a focal point for students and staff across all disciplines wishing to engage in entrepreneurial activities. The BEC offers assistance to entrepreneurs in promoting their ideas throughout the process of building a startup, including guidance by experienced staff, mentoring by experts, networking with leading entrepreneurs and assistance with fundraising.

The BEC also runs an accelerator for student startups and offers pre-seed loans for students with startup ideas, and delivers a range of undergraduate and postgraduate entrepreneurship courses in conjunction with individual faculties.

Technion has a strong focus on creating startups based on STEM skills, and recently announced the Technion-Cornell campus in New York City—a A\$640 million applied engineering and innovation precinct that will engage large numbers of engineering students from both universities in innovation and entrepreneurship-focused projects and studies.

All of Technion's student entrepreneurship programs are designed to articulate into the broader suite of startup programs supported by the government, including Israel's network of 22 startup incubators, which together support approximately 180 companies and provide each with up to A\$880,000 in government funding.

A feature of Technion's approach to entrepreneurship is the provision of a wide range of programs that students can access without having to undertake formal studies in entrepreneurship. Perhaps as a result of the strong pro-entrepreneurship culture in Israel and the country's numerous global successes, it is assumed that most students will have a broad awareness of high-impact entrepreneurship and will be able to identify the points at which they wish to engage during their studies.

WHAT ARE THE OUTCOMES?

An estimated 25 per cent of all Technion graduates have gone on to form a tech startup, with some having achieved significant success, such as Waze, which was acquired by Google for A\$1.6 billion.

Technion graduates have been estimated to comprise the majority of Israeli-educated scientists and engineers, constituting over 70 per cent of the country's founders and managers of high-tech companies, and 80 per cent of Israeli NASDAQ-listed companies are led by Technion graduates.¹⁰⁶

Israel is often held up as an example for other countries to follow, since it has successfully transitioned from a relatively low-tech economy prior to the early 1990s to one of the world's most vibrant technology-led economies today.

CONNECTING TO THE EXTERNAL STARTUP ECOSYSTEM

Connecting university entrepreneurship programs to the local startup ecosystem is essential to: (1) ensure the program is delivering guidance to students that aligns with practices in the real world, and (2) that the students gain some familiarity with the startup ecosystem which they will have to navigate if they decide to pursue their own startup.

This has been done very effectively by the Melbourne Accelerator Program (MAP) at the University of Melbourne, which has a strong emphasis on engaging local and interstate entrepreneurs to mentor the teams.

At the end of the three-month program MAP runs "Demo Days", where the teams pitch their startups to an audience of investors, other entrepreneurs and media in Melbourne, Sydney and Silicon Valley. MAP also augments the accelerator program with a wide range of events and workshops which can be attended by anyone.

MAP selects six student teams per intake to support via provision of A\$20,000 in funding, office space, mentoring and networking opportunities and is open to students, staff and alumni from all faculties. A total of 24 student startups have been supported by MAP, which together have raised A\$10 million in funding, created 120 jobs and generated A\$5 million in revenue.¹⁰⁷

MAP has been running for four years, making it one of the most mature student entrepreneurship programs in Australia. It receives funding from multiple faculties, enabling it to employ six staff who manage a high quality group of mentors with first-hand experience in startups. In 2014, it was ranked by UBI Global as the 13th best university incubator in the world.

Another notable Australian program is Startup Catalyst, an annual Silicon Valley immersion trip that takes 20 computer science students and recent graduates to San Francisco and Silicon Valley for 10 days of intensive meetings with startups and larger technology companies. It aims to immerse the participants in Silicon Valley's rich culture of high-growth entrepreneurship and to inspire them to become Australia's next batch of globally successful tech entrepreneurs.

The program is a philanthropic initiative of successful Australian entrepreneur and investor Steve Baxter, and currently accepts students from several universities in Queensland. The program will be expanded to have a national scope in 2016.

It is worthwhile comparing the scale of the above programs with that of the National University of Singapore's National Overseas Colleges program, which currently places 150 NUS students per annum in a six-month internship in startup hotspots such as Silicon Valley, and plans to double this number to 300 in 2016. The NUS program is directly supported by the Singapore government and represents a scale of student immersion which Australia would do well to replicate.

SUPPORTED BY LEADERSHIP

If Australian universities are to engender a culture of entrepreneurship on campus and make a significant contribution to boosting Australia's knowledge economy, it will be essential that vice-chancellors and other senior leaders actively promote the cause and engage the university community in a dialogue about the role of entrepreneurship in the university.

High-impact entrepreneurship is not yet widely viewed as a legitimate activity that belongs in the university environment in Australia. Experience shows that visible leadership can drive cultural change by signalling a clear intent to implement change and drive positive results.

A topical example is CSIRO, which is currently undergoing a major strategic shift that will see it place much greater emphasis on entrepreneurship than ever before. Under the direction of its new CEO, Dr Larry Marshall, (himself a successful entrepreneur and venture capitalist, having spent the last 25 years in Silicon Valley), CSIRO is establishing a raft of internal programs to train staff and students in Lean Startup principles, support potential startups via an accelerator that engages external entrepreneurs as mentors, and by creating a fund that will invest in startups formed by CSIRO staff and students.

According to recently appointed Chairman David Thodey, CSIRO will focus on "creating a greater culture of innovation and entrepreneurship in Australia".¹⁰⁸



If you want a great city, start with a great university. We believe Melbourne has all the elements of a great ecosystem of innovation and entrepreneurship. Through working together, universities, the city and its business leaders, new and established, can generate wealth and opportunity for all.

Just as Stanford has enlivened Silicon Valley, Harvard and MIT the innovation district of Boston, and Cambridge the industry precinct that now surrounds the university, the University of Melbourne is keen to ensure the city of Melbourne has a similar vibrant centre for innovation, incubation and transformation.

Professor Glyn Davis
Vice-Chancellor, University of Melbourne



As an Australian who spent 25 years in Silicon Valley, I passionately believe Australia's sub-par innovation performance is a critical national issue. There is no more potent fuel for creating enduring value than technology-enabled innovation. To do this, Australia must be a high-performing innovation economy. In an interconnected world of accelerating, technology-driven change, our future prosperity, health and sustainability is closely bound to our capacity for innovation.

To improve our performance and competitiveness, we must build the pipeline of STEM talent in Australia and build skills like entrepreneurship, project management and multi-disciplinary collaboration. We often talk about building 'T-shaped' leaders with discipline depth and cross cutting skills. For me the most critical national 'T' is STEM down, and innovation across.

As Australia's national innovation organisation, CSIRO is committed to helping build and equip Australia's future science, technology, engineering and mathematics (STEM) and innovation capable workforce. We want to create, enable and support successful entrepreneurs and intrapreneurs, and equip more of our workforce with the skills to create new high-technology industries and companies, and reinvent existing ones.

Larry Marshall
Chief Executive Officer, CSIRO

Over the last six months, CSIRO has embarked on a process of implementing the Lean LaunchPad course across all of its Flagships, and engaging with successful Australian and overseas entrepreneurs to deliver mentoring to aspiring CSIRO entrepreneurs, all as part of a suite of initiatives to boost entrepreneurship among CSIRO staff and the 750 PhD students it co-supervises with universities.

Dr Marshall and the CSIRO leadership team and board have made it clear that CSIRO is embarking on a new chapter, and that entrepreneurship is now an important part of CSIRO's strategy.

FOCUS ON VALIDATION, NOT BUSINESS PLANS

Business plans are entirely appropriate for established businesses, but of very little value to startups because nobody knows what the startup's business will be.

Best practice does not involve having students write business plans for startups. As noted by Morris, Kuratko and Cornwall, "Students produce elegant documents but fail to learn much about the reality of the entrepreneurial experience."¹⁰⁹

Startups are, at least in their early days, little more than a set of hypotheses that need to be tested by engaging with customers. Nonetheless, many business schools continue to deliver entrepreneurship courses where students must come

up with an idea for a hypothetical new business and spend a semester creating a lengthy document that sets out the future plans for the new venture, without any requirement to actually execute what is set out in the plan or test the assumptions with real customers.

Educators have been influenced by the work of Steve Blank, Eric Ries and others, that a startup is not a small version of a large company, but is in fact a temporary organisation whose purpose is to discover a viable and scalable business model.¹¹⁰ Instead of writing business plans, startup founders should learn about Lean Startup principles and focus their efforts on articulating and validating hypotheses by engaging with customers.

According to Franck Nouyrigat, Co-Founder of Startup Weekend, "Startup business plans are as good as following directions given by a blind chimpanzee."

Startup Weekends are an excellent example of the Lean Startup approach in practice. They are weekend-long, hands-on experiences where entrepreneurs and aspiring entrepreneurs can find out if startup ideas are viable. On average, half of Startup Weekend's attendees have technical backgrounds, with the other half having business backgrounds.

The event starts on Friday evening, when all participants are invited to give a 60-second pitch summarising their startup

idea and inviting others to join their team. Over Saturday and Sunday, teams form around the most promising ideas and work on validating these ideas and building a minimal viable product or prototype. On Sunday evening teams pitch their businesses, demonstrate their prototypes and receive valuable feedback from a panel of expert judges.

Startup Weekend originated in Boulder, Colorado in 2007, and is now operated by TechStars, a global network of startup accelerators. Since 2007, over 1,500 Startup Weekends have been held in 135 countries, involving 210,000 entrepreneurs and resulting in the formation of thousands of startups. Over 36 per cent of startups formed at Startup Weekends are still going after three months and roughly 80 per cent of participants report that they intend to continue working with their team after the weekend.¹¹¹

The first Startup Weekend took place in Australia in 2011, and since then a total of 41 Startup Weekends have been held around the country, engaging an estimated 3,000 participants.¹¹¹

STUDENT PLACEMENTS

Worldwide, universities are undergoing a shift from providing education largely separate from the workforce, to one in which education is integrated with work placements, internships and part-time work.

A study by the Australian Council for Educational Research commissioned by the Office of the Chief Scientist found that work-integrated learning (WIL) is increasingly common in Australian universities, but that its use to augment classroom-based teaching varies significantly between disciplines—with almost 75 per cent of ICT students undertaking an industry-based project during their degree, but only around 14 per cent of science students— notwithstanding that WIL is widely regarded as having a positive impact on the work-readiness of graduates.¹¹²

The value of work-integrated learning comes from the opportunity for students to experience first-hand the work environment for which they are training, enabling them to cement and apply the learnings from the classroom, to better understand the needs of their future employers, and to build valuable connections that can lead to future employment opportunities and professional relationships.

In the last decade, a growing number of universities around the world have taken a similar approach in their efforts to produce entrepreneurial graduates. They have found that

students derive immense value from placements within existing startups and other high-growth firms to augment their classroom-based entrepreneurship training and other experiential learning activities.

Internships work best when the students have regular debrief sessions with the academic team or course facilitator and fellow students, rather than placing the onus on the company for “teaching” them.

A global benchmark in student startup placement at NUS was previously described on page 47. Student interns work for up to a year in parallel with studies at local universities such as Stanford and KTH Royal Institute of Technology.

In Australia, very few universities are providing startup internships or exposure to overseas startup ecosystems, despite the obvious benefits of doing so. Two noteworthy Australian programs that do expose students to startups are:

- ▶ A student internship program run by the Australian Graduate School of Management at the University of New South Wales, which provides internships for its MBA students within Sydney-based tech startups. The program has had a positive reception from startups due to the strong business skills of the students that can be applied within the startup during their 12-week placement.
- ▶ Tin Alley beta—an internship program at the University of Melbourne that places computer science students as interns in local startups. The program now draws on students from Deakin University, La Trobe University, Monash University, RMIT University, Swinburne University of Technology and the University of Tasmania. It has placed a total of 27 students so far and expects to place a further 20 in the current year.

As yet, there are no large-scale startup internship programs run by Australian universities that focus on STEM students or that place significant numbers of students in overseas startup hubs.

CASE STUDY: NATIONAL UNIVERSITY OF SINGAPORE (NUS)

The entrepreneurship ecosystem at NUS¹¹³ is led by NUS Enterprise,¹¹⁴ a stand-alone division that provides entrepreneurship education and support across all university faculties. NUS Enterprise was formed in 2001, and delivers multiple streams of experiential entrepreneurship education including:

Lean LaunchPad—A 12-week intensive course delivered in person by the course’s creators, Steve Blank and Jerome Engel

Entrepreneurship Summer School—An annual intensive two-week residential course for international students to provide them with insights and connections in the Singapore entrepreneurial ecosystem

NUS Startup Runway—An incubator for startups that engages local and international entrepreneurs as mentors

National Overseas Colleges (NOC) program—An internship and overseas immersion program that places 150 NUS students per annum as interns in high-growth tech startups in hubs such as Silicon Valley, Beijing, Stockholm and Tel Aviv for up to a year in parallel with studies at local universities such as Stanford and KTH Royal Institute of Technology. The program launched in 2002 and will increase its scope to 300 students per annum from 2016.

iLEAD (“innovative Local Enterprise Achiever Development”)—A local counterpart to NOC which provides students with internships in high-growth Singapore-based companies and international companies expanding into the region.

WHAT ARE THE OUTCOMES?

As Singapore’s main university, NUS is widely regarded as having a major role in driving Singapore’s shift to an entrepreneurial culture. Between 2001 and 2015, NUS has supported the formation of 360 student startups and 1,800 students have completed the NOC or iLEAD programs, creating a large and valuable alumni base of entrepreneurs with global experience and connections.



The National University of Singapore’s National Overseas Colleges (NOC) program is one of the most impactful student entrepreneurship programs I have seen in Singapore, and indeed the world.

By placing 150 students a year as interns in startups in global tech hubs such as Silicon Valley, Beijing, Stockholm and Tel Aviv, we are inspiring the next generation of entrepreneurs and equipping them with immensely valuable skill sets and connections.

I believe the NOC program is one of the major factors in the palpable transformation to an entrepreneurially-driven economy that is underway in Singapore today.

Steve Leonard
Executive Deputy Chairman,
Infocomm Development Authority, Singapore

SUMMARY—BEST PRACTICE VS POOR PRACTICE

Table 8 contrasts best practice entrepreneurship education in universities with poor practice.

Table 8: Entrepreneurship education in universities—Contrasting best practice with poor practice

Attributes of best practice	Attributes of poor practice
Multiple opportunities for engagement	Single program
Experiential, strong emphasis on learning by doing	Theoretical, classroom-based
Encourages concrete action to pursue ideas	Encourages passive learning
Based on modern startup methods (eg. Lean Startup)	Based on out-of-date concepts (eg. writing business plans)
Encourages multi-disciplinary collaboration	Available only to a narrow group of students (eg. in business school)
Engages successful entrepreneur alumni as guest lecturers/mentors/teachers	Courses taught by academics with no first-hand experience in entrepreneurship
Connects with outside startup ecosystem	Isolated from external startup ecosystem
Available to students when they are ready	Taught at a set point in curriculum (eg. 1st/2nd year)
Students self-select into programs based on interest	Mandatory “ENT-101” course
Focus on growing the individual rather than their idea	Focus on the idea

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CHAPTER 5

A WAY FORWARD FOR AUSTRALIA

KEY POINTS

- ▶ The entrepreneurship education activities of most Australian universities are relatively immature by global standards.
- ▶ A number of Australian universities have recently launched entrepreneurship centres to give much-needed focus to their efforts to produce and train entrepreneurs.
- ▶ Several universities are developing plans for entrepreneurship teaching initiatives on a meaningful scale.
- ▶ Most offerings are still either at a too small a scale or not in line with international best practice.
- ▶ A lack of cultural support for high-impact entrepreneurship in Australia is one of the biggest obstacles to producing more entrepreneurs.
- ▶ A significant effort is needed to boost the capabilities of Australian universities to teach high-impact entrepreneurship and produce entrepreneurially-minded graduates.

MEASURING MATURITY OF ENTREPRENEURSHIP EDUCATION

The maturity of any university's entrepreneurship ecosystem can be categorised into six stages, as shown in Figure 11.¹¹⁵

University entrepreneurship programs typically develop over time from an initial starting point that may be no more than a single elective subject—often taught in the business school to mainly business students and by an academic staff member with limited first-hand experience of entrepreneurship (Stage 1).

Over time, those universities that invest in growing their entrepreneurship programs typically add some networking events and perhaps a startup incubator (Stage 2). Some even run business plan competitions, although efforts still tend to be mainly led by business schools.

By Stage 3, universities generally have a suite of entrepreneurship courses catering for undergraduate and postgraduate students, often with some being delivered outside the business school and tailored to science and engineering faculties. Some even establish a dedicated space to act as a physical hub for student entrepreneurship activities.

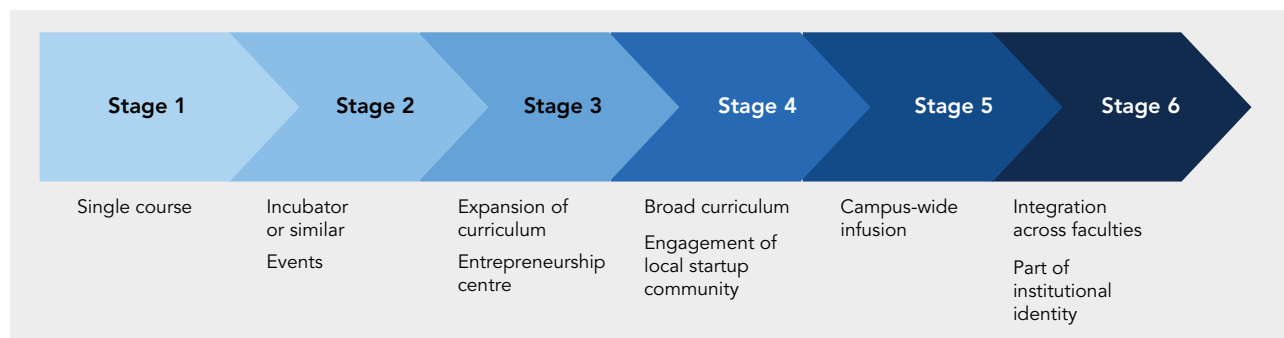
Stage 4 is characterised by further expansion of the teaching curriculum to a broad range of short courses, elective subjects and master degrees specialising in entrepreneurship. By this point, universities tend to have significant involvement of experienced entrepreneurs from the local startup ecosystem to help with creation and delivery of courses or as entrepreneurs-in-residence, and often two-way exchanges of expertise via internships, international trade missions, seed

funds and dedicated staff to support student entrepreneurs. They also have many hundreds of students actively engaged in entrepreneurship activities across the campus.

Many universities do not reach Stage 5 or 6, but those that do generally reach a point where practically the entire student population is exposed to entrepreneurship activities on some level. The identity of the university is closely linked with the concept of entrepreneurship, and the university has developed a track record in producing companies that go on to create significant wealth and economic impact. Universities at Stage 5 and 6 often have internal venture funds specifically for investing in student-led startups, and some enable alumni to become investors.

Based on the analysis in the previous chapter, it would be reasonable to conclude that universities such as University of Cambridge, Technion and National University of Singapore are at Stage 5, with Stanford and MIT at Stage 6, due primarily to the length of time over which those institutions have supported entrepreneurship combined with the highly entrepreneurial cultural environments in which they exist.

Figure 11: Framework for establishing maturity of entrepreneurship education in universities



Two specific measures of the maturity of student entrepreneurship programs warrant particular attention.

Quality:	Refers to the usefulness of the content in equipping students with applied skills and actually motivating them to take active steps toward becoming entrepreneurs. Indicators of high quality include use of best practice Lean Startup principles and courses such as Lean LaunchPad, engagement of experienced entrepreneurs as lecturers and mentors, and a focus on high-growth businesses rather than a more generic approach to entrepreneurship.
Reach:	Refers to the number of students that the programs are able to engage in a meaningful way. Universities that achieve significant reach typically do so by offering a large number of programs and courses that expose students to the concept of high-impact entrepreneurship in small doses and enable them to opt in to more involved programs based on their level of interest. This “learning journey” approach has been used effectively by universities such as University of Cambridge as a means of exposing a large percentage of the student population to entrepreneurship and allowing those with a more serious interest to pursue it further.

It is evident that for student entrepreneurship programs to have a material impact, they need to have both quality and reach.

STATE OF PLAY IN AUSTRALIA

To date, no formal assessment has been conducted of the maturity of Australian universities’ entrepreneurship programs. There is no national assessment of such programs as part of the evidence for universities’ impact on the economy. However, based on analysis including a detailed review of a selection of programs, and interviews with stakeholders in several of those institutions, some observations can be made about the state of play in Australia.

Entrepreneurship education in Australian universities is a relatively recent phenomenon, and most universities have only begun to extend their offerings beyond teaching business school subject in the last three to five years. It should therefore be of no surprise that a large number of Australian universities are at Stage 1 or 2.

A handful of Australian universities have progressed to Stage 3, and it could be argued that two or three are at Stage 4. None have yet developed their entrepreneurship programs to a level of maturity that would place them in Stage 5 or 6.

At a fundamental level, the main reason Australian universities lag behind their international counterparts is that we have come late to the party and are now having to catch up in response to student demand.

Many of the programs that currently exist in Australian universities struggle with achieving quality or reach (or both). Those that are not delivering quality programs often suffer from having out-of-date content that requires students to write lengthy business plans and does not follow best practice Lean Startup principles, or lack staff with appropriate first-hand experience. Many do not fully engage with the entrepreneurial expertise in the community to augment internal teaching resources, resulting in a sub-optimal experience for students.



Smart economies are built around smart people. Not every university graduate will be an entrepreneur, nor should we expect them to be, but they should leave our places of learning having learned how to be entrepreneurial in their wider approach to life. If we can raise the IQ—the Innovation Quotient—of our cohort of students, give them the tools and confidence and the ability to innovate and problem solve, we stand a good chance at transforming society through impactful education. This is a numbers game. With over a million people in higher education in Australia, if only 10 in every 1,000 of our graduates imbued with additional skills beyond their disciplinary knowledge goes on to translate that knowledge to innovation in enterprise, we will build and transform tens of thousands of industries for the future.

Professor David Lloyd
Vice Chancellor, University of South Australia

Those that do not have sufficient reach are often limited by lack of internal funding, lack of space, lack of available staff time (which is tied to lack of funding). There is also the barrier where the program is “owned” by a particular faculty or school, making it accessible to only a narrow slice of the student population.

A notable example of a high-quality but sub-scale program is the “Technology Venture Creation” course (ELEC5701)¹¹⁶ taught within the engineering faculty at the University of Sydney. The course was created in 2008 by Matt Barrie (an experienced serial entrepreneur, currently CEO of ASX-listed company Freelancer.com) and taught for several years by Matt and Bill Bartee (a serial entrepreneur and venture capital investor) with guest lectures provided by other experienced entrepreneurs from Australia and the United States.

The Technology Venture Creation course was based on entrepreneurship courses delivered at Stanford University and is one of the highest-quality entrepreneurship courses delivered at any Australian university. It complements other entrepreneurship programs at the University of Sydney, including the Incubate student incubator.

However, the course is only offered to electrical engineering students, with the result that it has only been taken by around 20 students per annum, increasing to 43 students in 2015. There has been strong demand from students in other disciplines such as science, mechanical engineering, aeronautical engineering, biomedical engineering, business and medicine, and the university is currently exploring ways to make the course available to a wider range of students.



I believe that our economic future depends on our ability to implement our ideas and create businesses that matter in a global context. It is therefore of great concern to me that Australian universities are lagging in the importance of exposing students to entrepreneurship, whilst in countries such as the UK entrepreneurship has been an integral part of student life in many universities for a decade or more.

Producing graduates with an entrepreneurial mindset and the practical skills to build technology-based businesses will support Australia’s much-needed transformation to a knowledge-intensive economy. This represents a significant new function for many Australian universities, and one that will require a substantial national investment.

Professor Michael Cardew-Hall
Pro-Vice Chancellor (Innovation), Australian National University

WHICH UNIVERSITIES ARE PRODUCING HIGH-IMPACT ENTREPRENEURS?

Figure 12, based on unpublished data collected by PwC for the Startup Economy study in 2013, shows the Australian universities at which the founders of Australian tech startups obtained their undergraduate or postgraduate degree, relative to the highest ranking (UNSW, indexed at 100).

Whilst the data is imperfect and does not track every Australian startup, it is the most comprehensive study available that explores the link between universities and graduate startup formation. There is no inherent bias in the study, therefore startups whose founders studied at any one university will have been under-represented to the same extent as startups whose founders studied elsewhere.

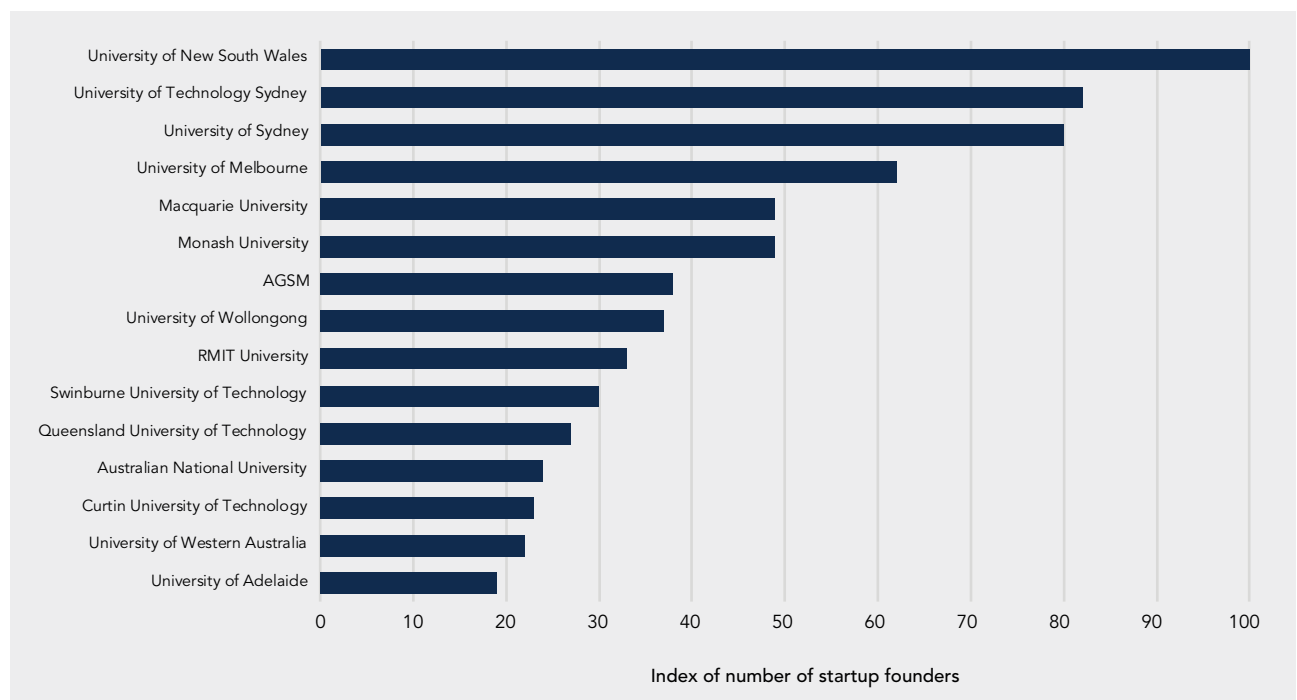
A more detailed analysis will be needed to fully understand the forces at play, but there is a clear correlation between universities that rank highly on this scale and the presence of a range of student entrepreneurship programs that are operating in line with best practice (i.e. deliver high quality) and at meaningful scale (i.e. have significant student reach).

PROGRESS IS BEING MADE

There is a clear trend towards Australian universities expanding and professionalising their student entrepreneurship offerings, and several universities have made significant strides in recent years.

To varying degrees, universities are starting to view student entrepreneurship as an important function and are putting in place a range of programs to expose students to high-impact entrepreneurship and support them as they form startups.

Figure 12: Australian universities ranked by number of startup founders (PwC, used with permission)



A number of universities have also created dedicated centres to act as the focal point of their entrepreneurship activities. Examples include:

<p>Michael Crouch Innovation Centre, University of New South Wales</p>	<p>An innovation and entrepreneurship centre located within the new Materials Science Engineering Building at UNSW's Kensington campus. Opened in September 2015 and supported by a donation from successful businessman Michael Crouch.</p> <p>The centre aims to foster a culture of innovation on campus, inspire an innovation mindset in every UNSW graduate, contribute to the innovation ecosystem in Australia and influence the emerging innovation economy.</p> <p>It is modelled on innovation centres at Harvard, Yale and MIT, and offers experiential learning programs, maker spaces, workshops, seminars and ideation events, and is open to students from all faculties at UNSW.</p> <p>The MCIC augments a wide range of existing student entrepreneurship initiatives at UNSW, including multiple student entrepreneurship clubs, undergraduate and postgraduate courses run by the business school, a venture incubator space in the School of Computer Science and Engineering, a Centre for Innovation & Entrepreneurship in the Business School which runs the Peter Farrell Cup business plan competition, a Startup Games competition for students that runs over four weekends, MBA student internships within local tech startups, a dedicated student mentoring service provided by three full-time UNSW Innovations staff (400 students supported so far), pro-bono legal advice for student and alumni entrepreneurs, and FounderLab, an on-campus product development team for non-technical student startup founders.</p>
<p>iAccelerate, University of Wollongong</p>	<p>A suite of entrepreneur education, acceleration and mentoring programs for aspiring entrepreneurs including UoW students. It was established in 2012 and will operate from a dedicated physical facility capable of housing over 200 entrepreneurs from April 2016.</p> <p>The main programs offered by iAccelerate are:</p> <ul style="list-style-type: none"> ▶ iAccelerate Start—An ideas incubator for early stage businesses ▶ iAccelerate Advanced—A tailored business acceleration program for more advanced companies with high growth potential ▶ iAccelerate Club—Engagement with successful entrepreneurs and networking opportunities. 1,300 members ▶ iAccelerate Mentor—Expert advice, knowledge sharing, peer-to-peer support ▶ iAccelerate Pitch—Present to industry experts and investors ▶ iAccelerate Educate—Tailored education program for entrepreneurs ▶ iAccelerate Seed—An early-stage fund that makes seed and follow-on investments in iAccelerate resident startups ▶ Students receive free access to iAccelerate services for 6 months.
<p>New Venture Institute, Flinders University</p>	<p>NVI is an entrepreneurship centre housed in a new A\$120 million facility as part of the Tonsley Park Innovation Precinct in Adelaide. It was established in 2013 and has the aim of nurturing an entrepreneurial community at Flinders and more widely in Adelaide.</p> <p>Student entrepreneurship programs include:</p> <ul style="list-style-type: none"> ▶ Internships with local startups ▶ Venture Dorm—A 12-week Lean Startup program for students modelled on the Lean LaunchPad ▶ eNVision Incubator Space—A co-working space for student startup teams ▶ Networking events such as Entrepreneurs in Conversation that engage experienced entrepreneurs as guest speakers.

* Examples provided here are intended as a snapshot of some of the more promising student entrepreneurship initiatives currently underway in Australian universities. They are not intended as an exhaustive list and numerous other high quality programs exist that have not been included.

CBR Innovation Network,
Canberra

The CBR Innovation Network (CBRIN) is an initiative of the ACT Government, formed in November 2014 to support innovative businesses and entrepreneurs in the ACT. Its focus is on growing an innovation ecosystem to help diversify and grow the ACT economy, including educating entrepreneurs in the ACT. The Foundation Members are the Australian National University, the University of Canberra, UNSW Canberra, NICTA and CSIRO. This unique collaboration engages students and other emerging entrepreneurs into the growing innovation ecosystem, with pathways into startups and large companies.

CBRIN links businesses and entrepreneurs with training, mentorship, events, co-working space and networks that will accelerate their growth.

Specific initiatives supported by CBRIN from a dedicated facility in central Canberra include:

- ▶ GRIFFIN Accelerator—a business accelerator program that provides seed funding and a 3 month intensive mentoring program
- ▶ Entry29—the largest co-working space for high growth businesses in Canberra
- ▶ HACT—a program to teach 10–17 year olds to code in the ACT
- ▶ KILN—an 18 month business incubator program including mentoring, office space and training
- ▶ STIR—a crowd-voted micro-grants platform for 15–30 year olds to get their projects funded and build entrepreneurship capability
- ▶ Inspiring the ACT—a program to promote and connect STEM and entrepreneurship in the ACT
- ▶ Workshops, training and events for entrepreneurs on topics including business validation, selling to grow, business model generation, accounting, legal and marketing
- ▶ Internship and networking opportunities for students
- ▶ CBRIN also facilitates links into the broader education and research capabilities of its member universities and research organisations, providing entrepreneurs with opportunities to access and leverage these capabilities.



The days of economic dominance by long-lived large corporates, and a majority of students keen to work in them, are passing. A significant portion of job and economic growth is and will continue to come from new high-growth technology companies, with many university students wishing to start up their own companies. STEM students will need to be prepared with entrepreneurial skills, experience and a supportive entrepreneurial community to grow in.

Dr Sarah Pearson
CEO, CBR Innovation Network

In addition, a number of universities are planning substantial new entrepreneurship programs that will be implemented in the coming years. Examples include:

Monash University	Monash University is developing multiple programs with the objective of cultivating a culture of student entrepreneurship, supporting the creation of more startups and spinouts and producing more experienced, well-trained entrepreneurs. The programs to be delivered commencing in 2016 include an idea pitching competition, a startup accelerator, a network of experienced mentors, a fellowship program to supports students as internal champions of entrepreneurship, a seed fund and an alumni angel investor network.
University of Technology Sydney (UTS)	UTS is catalysing an innovation precinct "Piivot" aimed at growing the existing vibrant startup ecosystem in Ultimo. Services to be provided by Piivot will include internships and mentoring for students, hosting events focused on high-impact entrepreneurship, development of new startup spaces, mapping the startup ecosystem and producing data on its performance. Piivot is modelled on successful overseas startup hubs such as Tech City London and Hub Singapore, and is supported by the NSW Government and multiple industry partners.
Ormond College, University of Melbourne	Ormond College is launching the Wade Institute in 2016. It will be a dedicated entrepreneurship institute that delivers undergraduate and postgraduate courses, including a master degree in entrepreneurship plus several short courses. The institute will operate from a dedicated facility being built following a A\$10m donation from alumnus Peter Wade. The institute will also provide a flexible workspace for students to pursue their startup ideas and receive mentoring from experienced entrepreneurs. It has been modelled on entrepreneurship centres at universities such as MIT, Cambridge and Technion.



At the University of Melbourne we are working to complement our world-class research by infusing entrepreneurialism into the culture—ensuring that in everything we do there is a clear sense of opportunity, an appetite for making a real difference, and an understanding of how to align interests in pursuit of a common goal.

Recognising that no single activity will achieve this objective, we will be rolling out a suite of initiatives— both top-down and bottom-up—aimed at building systematic commercial engagement machinery to enhance the richness and diversity of university life.

Doron Ben-Meir
Executive Director, Research, Innovation and Commercialisation, University of Melbourne

IMPLICATIONS

The Australian Government has been actively engaging with the university sector in recent times to develop improved funding frameworks that incentivise universities to produce teaching and research outputs that are of greater benefit to Australian society. This engagement is critical to the development of a coordinated national approach.

Australia is the only country in the OECD that does not have a science and innovation strategy, and lacks a consistent narrative about how the country will transition to a knowledge-intensive economy.¹¹⁷ A growing number of informed commentators have been urging the government to take urgent action to set a new course for the future Australian economy. Among the most recent was Catherine Livingstone, President of the Business Council of Australia, who recently noted that, “*there have been 60 reviews into innovation and at some point we have to stop asking the question and act (...) we need a more integrated plan for innovation, including encouraging startups and entrepreneurs.*”¹¹⁸

A comprehensive national innovation and entrepreneurship policy would provide the much-needed vision for the transition to a knowledge-intensive economy, and a meaningful long-term funding commitment from government would enable implementation of programs on a scale not previously seen in this country.

Such a policy would ideally be a comprehensive, whole-of-government approach, developed in consultation with key industry groups, entrepreneurs and thought leaders to ensure it can achieve significant change, and that it complements other current and proposed strategic initiatives.

Failing to make a clear distinction between high-impact entrepreneurship initiatives and other entrepreneurship initiatives (e.g. small businesses or social ventures) can dilute impact and create confusion about objectives.

The government has several programs which provide support to entrepreneurs. The Entrepreneurs’ Programme (in particular the Accelerating Commercialisation stream) is central to this, although its focus is largely on commercialising technologies and inventions within established businesses.

PROVIDE APPROPRIATE INCENTIVES FOR UNIVERSITIES

The main sources of government funding for publicly funded research in Australia are:¹¹⁹

- ▶ A\$2.7 billion for competitive research grants and other research support; and
- ▶ A\$1.9 billion through performance based block funding.

This funding is distributed to universities based on a range of measures of university performance, of which research output (as measured by peer reviewed research publications) forms a significant part.

The way in which the government assesses the performance of universities is a strong driver of behaviours, since it affects not just overall university funding allocations but also the reputations of individual academics and how they are viewed by their employers in terms of funding support and promotion prospects.

The process by which the government allocates funding to Australian universities does not take account of the impact of research (whether economic, environmental or societal). This produces three major consequences:

1. It drives academics to focus their efforts on producing publications rather than on engaging with industry or teaching students;
2. It discourages academics from pursuing applied research and commercial proof-of-concept work that will not lend itself to publications in top journals, even if it could lead to significant economic impact via creation of new technologies and startups; and
3. It steers academics toward research topics that are of academic interest and therefore likely to lead to publications in top journals and citations from other researchers, whether or not the research ultimately represents a good investment of taxpayer funds.

Excellence in Research for Australia (ERA) is just one of the mechanisms by which the federal government distributes research funding to universities. It has been in place since 2010 and is used to rate university research on measures of research quality.*

* The Australian Research Council (ARC) is responsible for administering ERA. More information is available at <http://www.arc.gov.au/excellence-research-australia>

The ERA framework is an important lever through which the government can influence the behaviour of universities.

ERA focusses on the excellence and quality of research and does not measure the impact that this research has on the economy and society. There is support for the measurement of economic, environmental and societal impact which would also then feed into the various mechanisms by which the government distributes funding to universities.

The government has initiated two reviews relevant to this issue—a review of research training arrangements by the Australian Council of Learned Academies (ACOLA) and a review of research funding, system performance measures and policy settings by Dr Ian Watt AO.

The current reviews of research training and policy settings present a timely opportunity to increase the emphasis on economic impact measures such as startups created by staff and graduates, capital raised and jobs created—with a particular focus on STEM disciplines.

Incentives linked to funding would also encourage universities to recognise academic staff for engagement in student entrepreneurship activities. Few universities have frameworks of this nature in place today. When staff do get involved with student entrepreneurship, it is often an unfunded activity or a labour of love.

In contrast, universities in the UK are assessed not just on quality of research but also their impact. The Research Excellence Framework uses impact as one of the three main elements for assessing research and allocating funding to universities. For the 2014 REF, impact was defined as “an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia” and includes entrepreneurial activities such as entrepreneurship education.^{120–123}

MEASURE ENTREPRENEURIAL ACTIVITY AND OUTCOMES

There would be immense value in undertaking an annual survey and data collection exercise to inform government and universities about the effectiveness of new student entrepreneurship programs, to help demonstrate the impact of these programs over time and allow for greater international visibility of Australia’s entrepreneurial ecosystem.

Most Australian universities do not track or report on the numbers of students who have completed entrepreneurship courses or participated in experiential entrepreneurship programs such as incubators, accelerators, internships or overseas missions. Nor do they attempt in any consistent way to measure graduate entrepreneurship outcomes such as companies formed, capital raised, jobs created or economic value created.

A lack of available data was highlighted as a concern in multiple interviews with stakeholders in the university sector. A consequence of having limited data is that universities and the government have little information about the current level of student exposure to entrepreneurship or the outcomes being produced.

COMMITMENT FROM UNIVERSITIES

A commitment from universities to establish best practice student entrepreneurship initiatives would greatly increase the number of graduates that have an exposure to entrepreneurship and practical skills, and in turn lead to more startups and a higher rate of success.

The efforts of universities will be most effective if entrepreneurship becomes a visible part of the university’s mission and vice-chancellors and university leadership teams demonstrate a genuine commitment to entrepreneurship by advocacy and support of entrepreneurship initiatives.

In parallel, universities could encourage greater involvement of academic staff in entrepreneurial endeavours by recognising and rewarding entrepreneurship activity, including supporting student entrepreneurship, as a part of career progression.*

* On 7 October 2015, Universities Australia released its 2016 policy statement highlighting the role of universities in educating students for innovation and entrepreneurialism. (Universities Australia (2016), *Keep it Clever: Policy Statement 2016*, p.3)

The implementation of a national program of entrepreneurship education could be guided by a steering group comprising entrepreneurs and leading entrepreneurship educators, who would help universities to ensure that programs align with global best practice and remain up to date in what is a rapidly evolving discipline area, as well as assist the government in reviewing and assessing proposals from universities for funding to support delivery of programs.

HARNESSING INDUSTRY

Industry (including startups and more established companies) has an important role to play in contributing to the development and implementation of entrepreneurship programs in universities. This engagement should include providing universities with feedback on skills needs, providing opportunities for work-integrated learning and internships, advising on program design, providing suitably experienced mentors, and supporting efforts to connect the university with activities in the broader startup ecosystem.

It will take some time to organically build up a large cadre of experienced entrepreneurs who can cycle back into the startup ecosystem to guide new entrepreneurs.

This talent shortage could be short-circuited by injecting successful entrepreneurs from around the world to help bridge the expertise gap whilst the local talent pool matures. The establishment of a prestigious national Entrepreneurs-In-Residence program would be an effective way of engaging successful entrepreneurs in Australian universities. These positions could be created within universities and be focused on actively engaging with students in experiential entrepreneurship education, and supporting the creation and growth of startups.

With suitable reward and recognition, universities would be able to attract high-calibre individuals who will act as a catalyst within the university and as a conduit to the local and international startup ecosystem.

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CHAPTER 6
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APPENDIX A

TERMS OF REFERENCE

1. A clear definition of entrepreneurship as it relates to STEM disciplines, in particular identifying the difference between small business entrepreneurship and high-impact entrepreneurship. This will include a discussion of the following points:
 - a. The cultural dimensions of stimulating high-impact entrepreneurship in Australia and possible approaches to addressing cultural obstacles
 - b. The arguments for high-impact entrepreneurship as a driver of economic growth and for national investment in the development of entrepreneurial skills in STEM students
 - c. The distinction between IP commercialisation and entrepreneurship in a university context
 - d. Initiatives that have contributed to development and utilisation of entrepreneurial skills in STEM students—such as student incubators, entrepreneurship clubs, overseas placements, mentoring programs, hackathons, seed funding mechanisms and university policies.
2. Literature review including peer-reviewed academic literature and industry publications to identify:
 - a. Evidence whether there is a correlation between entrepreneurship education and successful entrepreneurial outcomes, and an assessment of the likely causality
 - b. Leading universities worldwide which have produced STEM entrepreneurs who have developed significant companies with global reach or global potential
 - c. Education and other initiatives that these top-performing universities use to equip STEM students with entrepreneurship skills
 - d. Comparative international data on the scale and impact of entrepreneurship education in universities
 - e. In particular, focus on initiatives which have succeeded in developing an entrepreneurial culture and in changing the ‘traditional’ culture and behaviour of university academics, students and graduates.
 - f. Identify what education and other initiatives do not work in achieving the required outcomes listed above.
3. Identify and construct a map of the skills required for entrepreneurship.
4. Identify the world’s top universities which have produced the most STEM entrepreneurs who have developed significant companies with global reach or global potential.
5. Define and describe the education and other relevant initiatives that these universities use to educate STEM graduates and post graduates. In particular, focus on initiatives that have been effective in locations that have not historically had a strong entrepreneurial track record, and have been successful in changing the culture and behaviours.
6. Identify the top Australian universities that have produced the most STEM entrepreneurs. Define and describe the education and other relevant initiatives that these five universities use to educate STEM graduates and post graduates, and discuss what needs to happen to scale these up.
7. Define the elements of success for entrepreneurial education for STEM graduates.