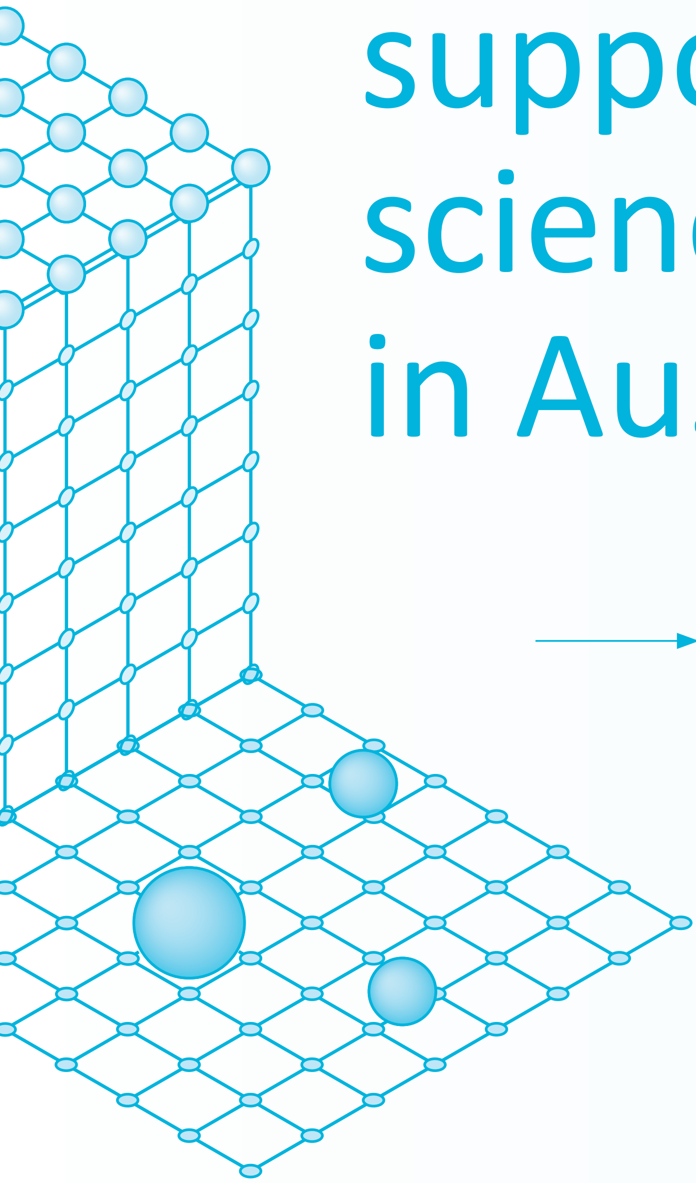
Spinning out: supporting science start-ups in Australia



Systems Research into Science Entrepreneurship in Australia, focusing on the lived experience of scientists aiming to commercialise their research.

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Foreword

The Menzies Foundation aspires to raise the profile and importance of 'outstanding' leadership. We do this by identifying leadership challenges and building multi-sector incubators to explore new ways to address these challenges and build leadership capability.

One of the Foundation's key areas of focus is supporting the development of entrepreneurial scientists to harness and exploit new opportunities from innovation in science and technology.

Australia has an outstanding record in science and a highly regarded health system and yet Australia's most brilliant scientists struggle to build successful science enterprises. Addressing this challenge is key to Australia's future as we work to build the industries and companies of the 21st century and beyond.

This Report, commissioned as a foundational platform for the Foundation's interventions in science entrepreneurship incubation and support, captures the stories of these entrepreneurs, deepens our understanding of the impediments and barriers they face and provides a roadmap for what steps can be taken to support these future Australian leaders.

The Foundation is delighted to launch this Report and looks forward to working collaboratively across the system, beyond the silo's, to support Australian science and its entrepreneurs.

Liz Gillies

CEO, Menzies Foundation

Executive summary

There is an important nexus between science discovery and its translation.

The Australian science ecosystem has multiple conduits for this translation. Licensing agreements and patents by scientists and/or their academic organization and different forms of partnership with local biotech organizations (NGO's, hospitals and the private sector) and the international pharmaceutical industry are established platforms for taking science discoveries to market. Different approaches are adopted depending on the circumstances of the discovery process.

Another important conduit is the spin out of enterprises by science entrepreneurs to take science discovery to market. While there are many ways that scientists can be entrepreneurial, Australia still faces significant challenges translating good science into new, scientist-led companies. This isn't a new problem: systemic barriers to commercialisation including funding, attitudes, scale and incentives have existed for decades.

Science innovation start-ups build on tangible scientific discoveries. They derive value from a scientific discovery or an engineering innovation, as opposed to a business model innovation.

That said, discovery itself is not enough- success of science commercialisation depends on the availability of trained and dynamic entrepreneurial scientists, or 'science entrepreneurs'. And what makes a good science entrepreneur is different than what makes a good scientist. To increase the number of science-based, deep technology start- ups, we as a nation need to get better at producing a pipeline of high quality science entrepreneurs who are supported to build enterprises in Australia, whatever pathway to commercialisation they choose.

This Report specifically focuses on the experience of science entrepreneurs who wish to 'spin out' and build successful commercial enterprises in Australia. We interviewed science entrepreneurs with a range of experiences with commercialisation, at different stages of a start-up commercialisation journey. We sought to document the experiences of science entrepreneurs attempting to commercialise research using this pathway, in order to identify the systemic, institutional and circumstantial levers for change that influence success.

We found that outcomes, attitudes and behaviours of these entrepreneurs are determined by:

- The **origin** of their innovation or business idea
- Their **personal motivation** for the type of impact they wish to make; and
- A **changed perspective** of their future career and lack of certainty and job security within research

We identified three archetypes of science entrepreneurs that can be used as an interpretive tool to understand what specific barriers exist to commercialisations:

1. **Discoverer:** a science entrepreneur who is driven by a passion for their research and the potential impact it could have in the world.
2. **Translator:** a science entrepreneur who enjoys understanding problems that exist in the market, and connecting the dots between their scientific expertise and identified opportunities.
3. **Visionary:** a science entrepreneur who is driven by making systemic impact, and sees scientific expertise as a competitive advantage in starting a business.

We used Systems Practice to identify the barriers and enablers to research commercialisation, focusing on the experience and journey of science entrepreneurs in early-stage start-ups. We identified six areas of opportunity to influence the science entrepreneur pipeline and start-up outcomes.

1. Inspire and enable scientists to access industry commercial pathways; either through direct involvement or through observation
2. Inform through industry-led training and tailored mentorship the elements of commercialisation to reduce the perceived complexity and understand common routes to market
3. Intellectual property foundations including global patent positioning, inventor access and models of 'standard' practice globally
4. Fundamentals and principles of investment capital, the required alignment for researchers and how best to prepare for investor consideration
5. Changes to the incentives for researchers to allow commercialisation activities to be recognised as success, impact and value; eliminating the 1970's British rhetoric of "publish or perish
6. Industry mentors to engage with scientists to discuss the merits, and advise on how to explore entrepreneurship and taking the next steps

By acting on these areas of opportunity Australia can improve the translation of public sector research for economic and social benefit.

For each of these areas of opportunity we have identified a number of levers for change: points of intervention in the system that are likely to have a desirable impact to support science entrepreneurs within early-stage start-ups founded on scientific innovations.

It is important to note, not every scientist will choose the entrepreneurial-startup path, and this path is not the most suitable for every scientist. There are many avenues for scientists to access, and experience, elements of the commercial world and actively participate:

1. **Licensing:** a common method to transfer knowledge and value, through IP to an organisation with the capacity and capability to commercialise the technology. In some cases, the scientist will be involved on the advisory board or employed as a scientific advisor
2. **Industry partnerships:** collaborating with an industry organisation to jointly contribute towards a 'commercial discovery project' focused on market need and real-world solution
3. **Scientific expert:** Engaging with industry (start-up, SME, etc) to inform on the technical and/or scientific merits of their strategy

Although there are a number of successful examples of scientists successfully working in partnership with research institutions to commercialize science discovery, this is not a universal experience and is largely dependent on the attitudes and processes of the respective research institution conducting the negotiation. Science entrepreneurs interviewed for this report stated that this is often a difficult and complex process and consequently there is an opportunity to improve intellectual property negotiations by **lobbying to address non-competitive IP terms set by some research institutions.**

In order to bring their innovation to market, science entrepreneurs in early-stage startups need funding appropriate to the type of innovation they are seeking to commercialise. They also need the support of investors to access this funding. There is an opportunity to influence investor attitudes towards science innovation start-ups by **helping investors see value in science innovation investments** and **generating evidence of science innovation investment success.**

Designing interventions to act on these levers for change will help shift national priorities in Australia, advancing funding and incentive structures that better recognise and support science entrepreneur needs.

This Report

This report is broken into 5 parts:

Part 1

Introduction, detailing the rationale and methodology of the project.

Part 2

The Current Science Entrepreneurship Ecosystem, detailing the findings of a literature review into the current structures, policies and supports around science entrepreneurship in Australia.

Part 3

Science Entrepreneurs and their start-up Journey, detailing the qualitative findings of our research into science entrepreneurs and their experiences- reporting on the views of those interviewed for this research.

Part 4

Systemic Interventions, detailing our systems analysis and recommended intervention points.

Part 5

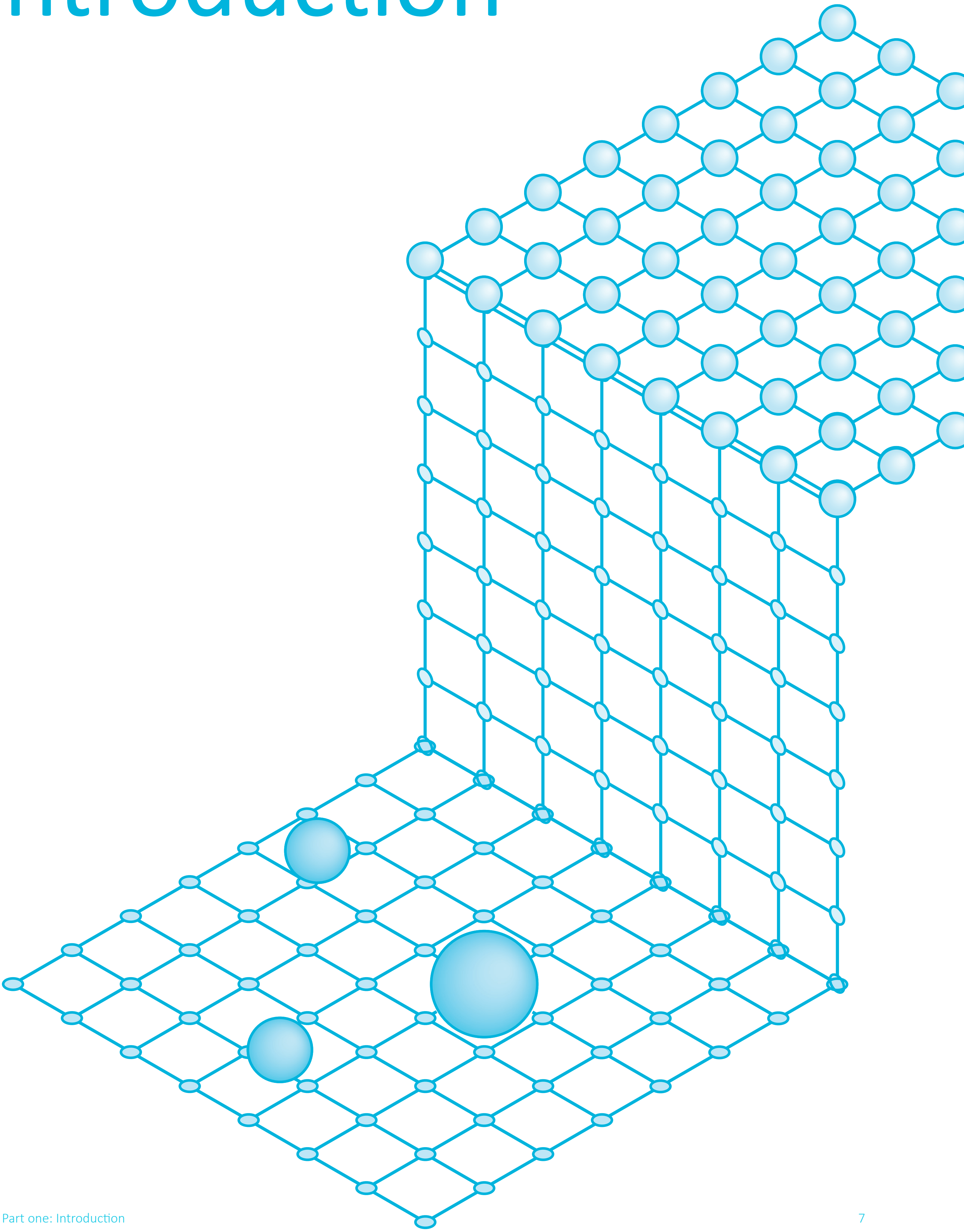
Next Steps, detailing our recommendations for what to do next.

Terms used in this report:

- **'Start-up'** refers to a company or project begun by an entrepreneur to seek, develop, and validate a scalable economic model.
- An **'early-stage start-up**' is a start-up yet to successfully develop and commercial ise their model or innovation.
- **'Spin out'** or 'spinning out' refers to scientist(s) starting a new company where the founders drive private commercialisation of intellectual property indepen dent of their institutions, usually leaving the employ of their institution in the process.
- **'Science entrepreneurs',** where used, refers to scientists that share similar expe riences to those we spoke to- namely, scientists who have chosen the 'spin out' commercialisation pathway. The term is not intended to be broadly reflective of the experience of all possible entrepreneurial contexts.

Part one

Introduction



The case for science entrepreneurship

Australian research ranks well by international standards and Australia spends more than the OECD average on public research and development. Our ability to effectively translate this public sector research lies at the core of Australia's future competitiveness and prosperity.

The success of science commercialisation via a start-up pathway depends on the availability of science entrepreneurs. A science entrepreneur is someone trained in science who wishes to combine their focus on research and/or applied science to pursue the commercialisation of their science output.

Australia can improve the translation of public sector research for economic and social benefit by supporting more scientists into entrepreneurship and through their commercialisation journey.

This project seeks to understand the systemic factors that mitigate scientist entrepreneurs aspirations when attempting to commercialise their research. It also sheds light on the experiences of current and past science entrepreneurs. These insights are then used to identify 'intervention points' in the system that are likely to support those science entrepreneurs who wish to 'spin out' to develop successful enterprises.
Before we report on our findings, this section will summarise

Traditional catalysts for innovation are in decline

Nation-wide, manufacturing has declined in alarming ways, and manufacturing output and employment have fallen steadily as a share of the Australian economy for the past three decades (Reserve Bank of Australia, 2017). Textiles and farming are under threat. The auto-industry has all but disappeared. Mining is being caught in the crossfire of recent rising global tension between China and the West.

Even those areas of significant strength and value- from financial service to law, from consulting to media- seem increasingly under threat from automation, from AI, from new technologies.

In this context, there is increasing consensus that Australia needs to prioritize creating new industries, new technologies and new ventures to position us for a bright future.

Australia has a problem translating good science into new companies. This isn't a new problem: systemic barriers have existed for decades. But it is being exacerbated by changes to industries that have historically invested in science.

The manufacturing and extractive industries are major drivers of innovation worldwide (as measured by new patents and IPs), with historically robust research and development programs. However, as a country with high labour costs, Australia has seen a steady, gradual decline in manufacturing sector jobs. This both reduces the amount being spent on Research & Development (R&D), and means there are fewer jobs available for scientists who want to work in the commercial sector.

While our extractive sector is still strong, companies are responding to the high cost of labour by prioritising large-scale process automation over more wide-ranging R&D. It is that type of wide-ranging (and well-funded) R&D program that leads to breakthroughs, including patents and other forms of intellectual property.

The need for 'deep tech'

Science innovation (or 'deep tech') start-ups build on tangible scientific discoveries. They derive value from a scientific discovery or an engineering innovation, as opposed to a business model innovation.

These technologies and innovations can create significant impact, with the potential to shape new markets or disrupt existing ones. They seek to deliver something that is a significant advance over existing technologies.

An increase in the number of innovative science-based start-ups and established businesses will lead to an increase in business growth, profitability and employment, more commercialisation of Australian research and ideas, and an embedded culture of innovation, entrepreneurship and risk-taking in Australia. This will lead to national economic growth, increased business competitiveness and improvements in the standard of living in Australia.

The forecasts for the next decade suggest we are entering a technology revolution. This new era will provide new opportunities, deliver new applications across a multitude of industries, update old manufacturing practices, respond to consumer needs and solve the challenges associated with changing social and environmental landscapes.
But this can only be achieved through the successful adoption, translation and commercialisation of these emerging and enabling technologies. The significant value associated with such growth requires entrepreneurial leadership, capital injection and a sophisticated skill base.

In theory, Australia should be well placed to exploit and take advantage of the new emerging opportunities in deep technology given our industrial capability, extensive research foundations and relatively stable fiscal position.

Australia currently underperforms with respect to commercialisation compared to our international competitors. Thus, Australia's opportunity to exploit the nation's research investments through technology translation into advanced manufactured commercial products is not being realised.

Funding – then de-funding – an innovation ecosystem

In 2015, the Turnbull Government attempted to address the research commercialisa- tion challenge by launching the National Innovation and Science Agenda (NISA), a policy statement on innovation and science and 24 associated measures. These measures included $1.1 billion in associated funding for new grant programs, tax incentives, STEM education, and research infrastructure.

Innovation policies focused on breaking down barriers to entrepreneurship by providing new entrepreneurs with the supportive infrastructure to found and scale new businesses. "Incubator" and "accelerator" models, popular with Silicon Valley venture capitalists, were customised for the Australian market.

Australia is now recognised as a growing regional hub for enterprise "software as a service", fintech and digital technology start-ups. Since 2011, more than fifty companies founded by Australians now have valuations of more than $100 million USD. Several "unicorns" – start-ups valued at more than $1 billion USD – have brought further talent and investment to the Australian ecosystem.

The program that most directly supported science entrepreneurship was CSIRO ON, a publicly funded science and technology accelerator, aimed at supporting teams of researchers from Australia's publicly funded research organisations. Funding for the ON program was provided through NISA.

However, following a change of Prime Minister, the government's current rhetoric has shifted from innovation and is currently more focused on supporting enterprise development rather than entrepreneurship.

Despite the successes of Australian digital tech start-ups, we are still not seeing businesses achieve success by translating applied science research. None of the highest-valued 25 start-ups in Australia have delivered science innovation or "deep tech" products to market.

Where are the entrepreneur scientists?

A scientist looking to take the pathway of a deep-tech startup to commercialise their work must determine possible application areas and acquire financial resources for commercialisation, which depends on the individual's technical expertise, previous experience gained in commercialisation, and their industry network outside of academia. This requires a broad range of skills and resources beyond the scientist's core expertise.

Scientists' aspiration and willingness to engage in commercialisation is also critical. For many scientists, their progression within science academia has taken many years, or decades, and the decision to shift focus is not taken lightly. While an individual's reasons for pivoting toward commercialisation are multifaceted and personal, they will be influenced by the incentives provided, the perceived risks, and the expected benefits. There are also well-known structural barriers in Australian business and research sectors that have existed for decades, which make it difficult for scientists to commercialise their research. These barriers include the poor collaboration between Australia's business and research sectors and the small size of the Australian market (specifically the limited amount of venture capital available). These structural barriers in turn are reflected in an individual scientist's perception of the costs and benefits of commercialisation.

How can we create a pipeline of science entrepreneurs to create the industries of the future?

Realising the potential of science entrepreneurs

To increase human capital in the entrepreneurial ecosystem, universities and research institutions need to produce graduates with relevant entrepreneurial knowledge and skills. This project focuses on understanding the factors that influence the success of early-stage businesses founded on scientific innovations.

There are several interesting global models which show the potential of a 'talent investor' approach to support entrepreneurship. However, due to a lack of consistent evaluation frameworks it has been hard to determine how effective these models are. High-potential science entrepreneurs need to be uncoupled from the institutional contexts that constrain entrepreneurial potential, and as such the system requires a new, disruptive mechanism to support the development of a 'talent pipeline' of science entrepreneurs.

This Project

This project focuses on understanding the factors that influence the success of early-stage start-ups founded on scientific innovations, and the experience of science entrepreneurs as they attempt to commercialise research via this pathway.

Our project has a guiding research question:

How might we unlock the resource pipeline to science entrepreneurship to create the industries of the future?

While there is ample research that highlights the relative underperformance of Australia at a macro-level when it comes to commercialising public sector research, there has been little research that focuses on the systemic factors that act as barriers or enablers to the success of individual science entrepreneurs. This project aims to shed light on the experience of science entrepreneurs as they aim to commercialise scientific innovations via the start-up pathway.It also aims to take a systems view on the science start-up experience so that high-impact intervention points can be identified, and meaningful and scalable interventions designed and deployed.

To achieve these aims, the project interviewed science entrepreneurs at various stages of their journey of starting their own businesses. All participants had been involved in an incubator program, and all participants cited their involvement in these programs as a key catalyst to starting their business. As such, the research is limited to this narrow but important aspect of research commercialisation, and does not speak to other forms of commercialisation (such as IP commercialisation within a university) other than from the perspective of those who have chosen the start-up pathway for themselves.

The claims, models, and recommendations in this report are based on the lived-experience of people who have attempted, or are attempting to take this commercialisation pathway.

To help validate and support these claims, the project has also:

- Conducted a literature review and scan of the current ecosystem related to research commercialization via the start-up pathway;
- Interviewed sector stakeholders, from incubator programs, government, research institutions and aademia.

This report details our findings and presents a series of recommended intervention points. Designing solutions for these points of intervention is likely to improve the pipeline of science entrepreneurs wishing to develop successful enterprises, and unlock the resources to support them.

Changing the research commercialisation ecosystem

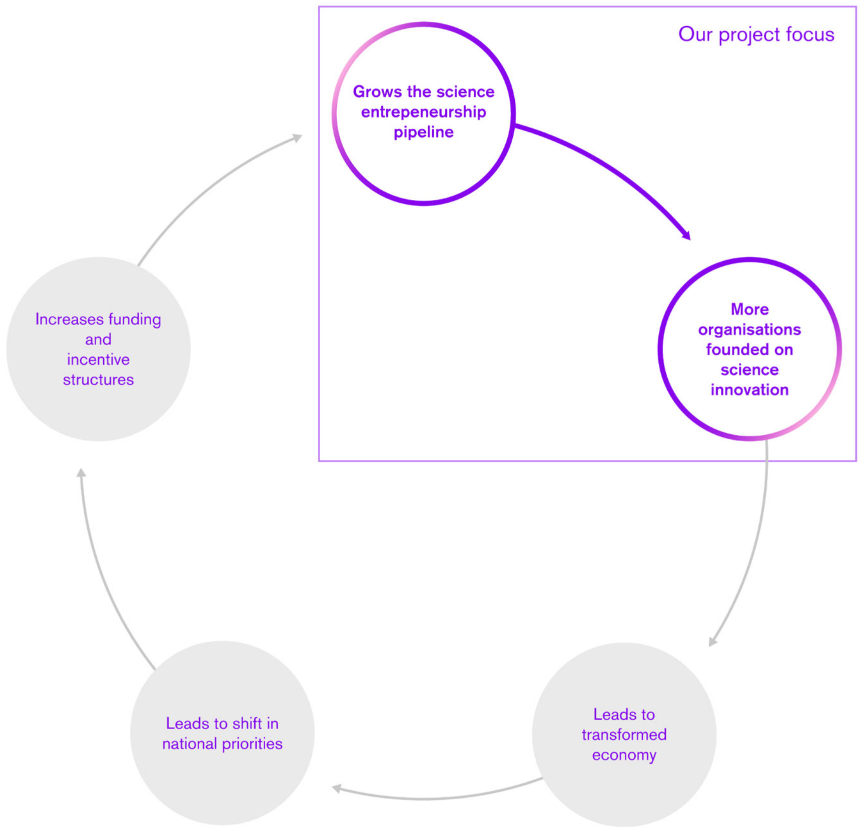


Figure 1: The Virtuous Cycle of Science Entrepreneurship.

Growing the science entrepreneurship pipeline, by increasing the number of science entrepreneurs, and making more resources available to them, will start a "virtuous cycle"- a self-reinforcing loop that will help transition Australia to a more sustainable economy (figure 1).

Our research indicates that:

- An increase in organisations founded on science innovation relies on a pipeline of science entrepreneurs attempting to commercialise research.
- The broader impact of more organisations founded on science innovation leads to a transformed economy – from industries reliant on extracting natural resources to a knowledge-based economy that drives innovation and leads to new products, services and businesses.
- Demonstrated success in this area will help shift national priorities in Australia, advancing government funding and research institutional incentive structures such as continuous financial investment that better recognise and support science entrepreneur needs.

Our project posits that, by better understanding the experience of a science entrepreneur and the impacting influences, we can recognise where change is required and is possible.

With this in mind, our project has two immediate aims:

1. To create foundational research that documents the experiences of science entrepreneurs attempting to commercialise research via a start-up pathway in order to identify the systemic, institutional and circumstantial levers for change that influence success across the entrepreneurial journey
2. Providing direction on those levers for change where it is possible to break down barriers or influence factors that shift the system in a positive direction, highlighting what has led to the factor (upstream causes) and the effect influencing the factor can have (downstream effects)

Researching the science entrepreneur experience

To help achieve this project's aims, we conducted qualitative research with science entrepreneurs in the midst of a start-up journey, as well as sector stakeholders, to understand their first-hand experiences of commercialisation.

We focused on:

- Understanding the typical journey and experiences of science entrepreneurs who have attempted to, successfully or unsuccessfully, commercialise a science- based innovation via a startup pathway.
- Understanding the broader ecosystem of structures, policies, incentives and supports designed to encourage science entrepreneurship.
- Identifying the current challenges and opportunities within the ecosystem, so that we could identify the most effective points of intervention.

Applying systems practice

This research has been analysed and reported on using a methodology known as Systems Practice.

Systems Practice is both a research methodology and a more general approach to grappling with adaptive problems in complex environments, with the aim of making enduring social change at scale (Omidyar Group, 2017).

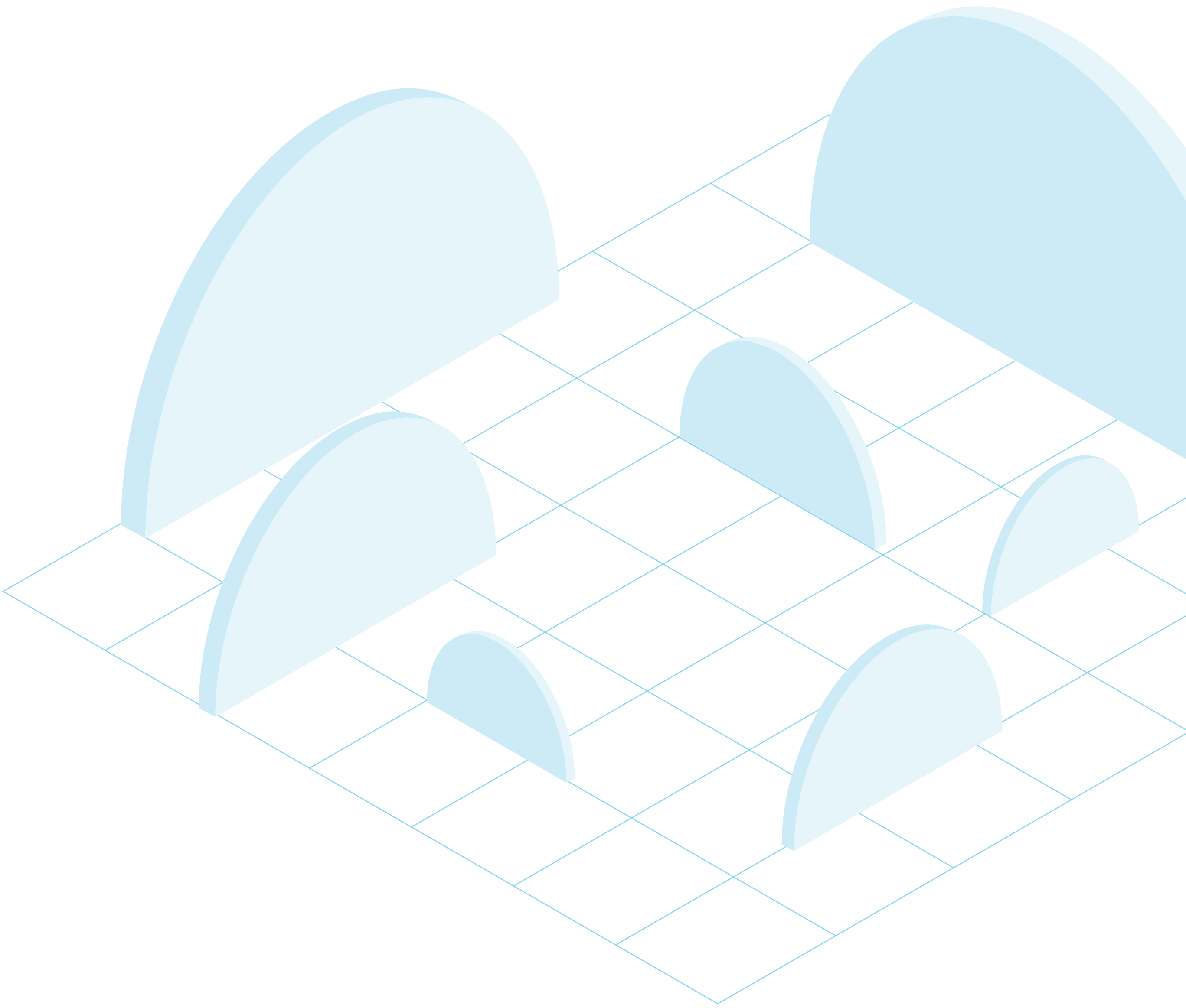
As a general approach to problem solving, it helps document and map the key actors, influences and dynamic forces within complex systems. It also helps identify the key levers for change within the system to achieve a desired impact.

We have used Systems Practice through this project to identify the barriers and enablers, focusing on the experience and journey of science entrepreneurs who wish to pursue the start-up pathway.

We have included the systems maps used in our research synthesis as an appendix to this report.

Part two

The Current Science Entrepreneurship Ecosystem



Introduction

The Australian Science Entrepreneurship Ecosystem is the result of collaboration between Federal and State governments, Research Institutions and Industry partnerships. This section provides a high-level overview of the ecosystem, and a review of the current known challenges.

The current science entrepreneurship ecosystem

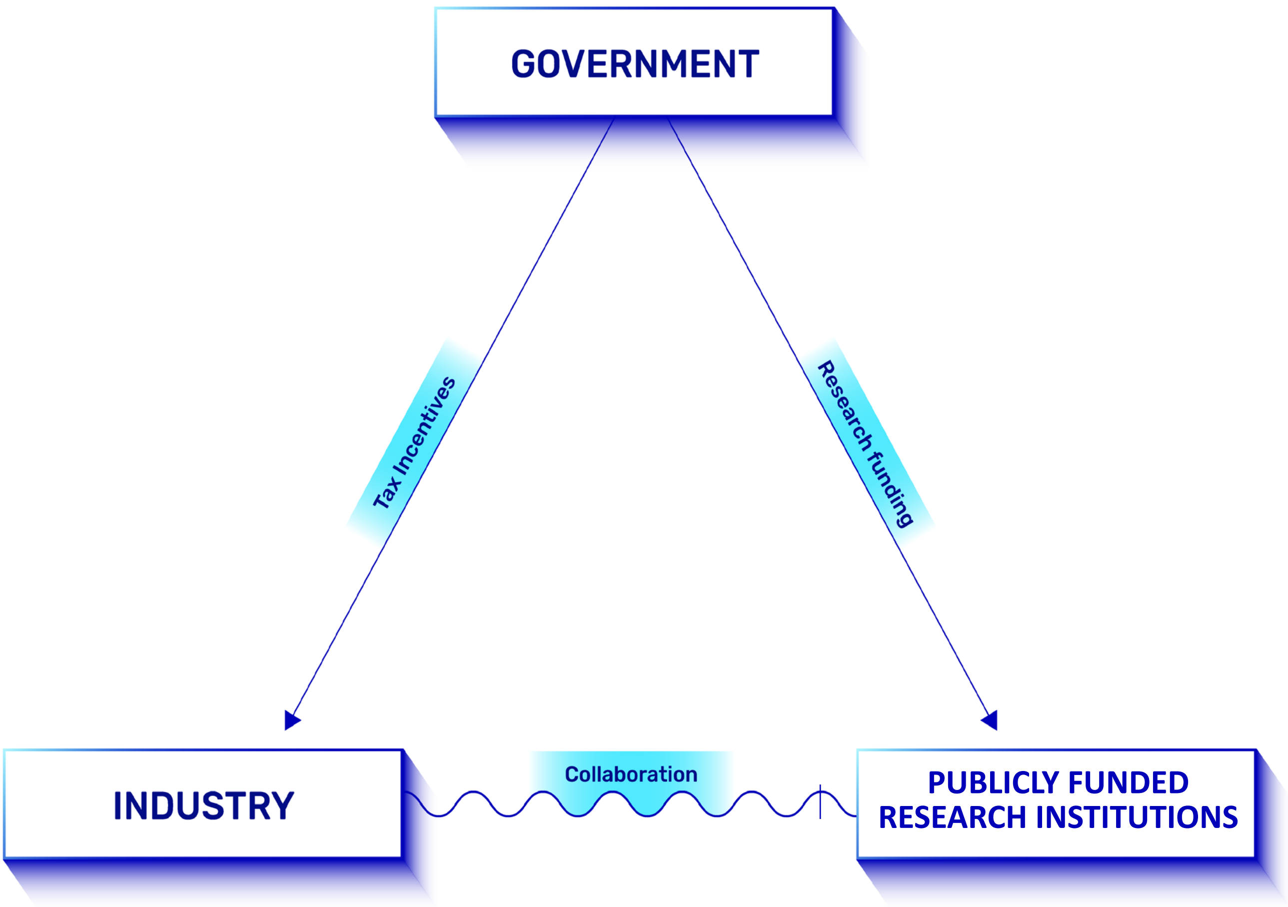


Figure 2 identifies the key players and flow of financial government support that contributes to the Australian science innovation ecosystem.

Currently, the Australian **government** provides funded research grants to **publicly funded research institutions** and R&D tax incentives to the private sector **(industry)**. There are also industry research grants that encourage collaboration between private sector and publicly funded research intitutions.

Figure 2: Government, Industry and Publicly Funded Research institutions work together to encourage science entrepreneurship.

Known challenges in the current system

There are significant gaps and disconnections in the Australian innovation ecosystem. Researchers are ill-connected to commercialisation experts. Venture capitalists are disconnected from high-quality deal flow. Innovators struggle to move easily between contexts- between publicly funded research institutions, the innovation ecosystem and the broader market. Entrepreneurs struggle to access, navigate or engage the wealth of potential in research institutions, or in the corporate sphere, or investment communities.

The silos and cracks in the system inhibit rather than unleash potential in deep technology innovation and commercialisation.

And while centres of excellence- pockets of brilliance- have started to spring up around the ecosystem, much work is to be done for these to become the rule, rather than the exception, in supercharging the system and its outputs.

To inform the research design we conducted a detailed review of literature and data to frame the known problems within the science entrepreneurship ecosystem.

We have synthesised the key findings from that literature review here into four main themes: **funding; values; scale, and incentives.**

For a full list of the sources used in this literature review, please see References.

1. Inadequate and unstable funding

Funding is a well-known barrier to science innovation in Australia:

- The translation of public sector research is currently hindered by unstable and short term funding due to frequent government policy changes. When there is a change of political leadership at the Commonwealth level, the tendency for new leaders to “burn” everything successful from the previous leadership party makes any entrepreneurial programs supported by policy extremely vulnerable (Innovation and Science Australia, 2017).
- A lack of access to capital and unstable government funding makes it difficult for science entrepreneurs to structure research around reliable funding sources.
- A program designed to support collaboration and commercialisation of research requires consistent and adequate funding to make impact and substantially grow science entrepreneurship.
- The government’s R&D Tax Incentive provides a financial boost to the private sector encouraging investment into R&D, however, it does not promote collaborative research outcomes between industry and research institutions (University of Melbourne, 2015)
- It is reported that businesses that undertake R&D are more likely to become involved in the translation of public sector research. While the Australian government offers support for business R&D through the R&D tax incentive, it does not have a targeted focus on supporting research collaboration and translation (Australian Council of Learned Academies (ACOLA), 2015).

- With a number of notable exceptions, like CSL, Australia lacks a significant number of larger firms prepared to engage in significant R&D or commercialisation programs and consequently universities play an important role in developing science innovation breakthroughs.
- The university sector's ability to pursue and support research that may lead to commercialisation is challenged when government funding is reduced.
- Within the university sector, there is a funding bias shown to favour established, research-intensive universities over newer, regional universities limiting access to commercialisation pathways to fewer academic institutions overall (Battisti et al., 2019).

2. Misalignment of values

A misalignment of values between key players is shown through the cul- tural attitudes and behaviours toward science innovation:

- In order to experience a healthier culture of science innovation in Australia, more can be done by government to encourage and support experimentation through science-focused entrepreneurship programmes.
- Universities play a crucial role in developing and nurturing entrepreneurial opportunities as well as equipping graduates with the relevant knowledge and skills to pursue commercialisation. The current academic value system hinges on rewarding published outcomes that raise the institution's profile and attract new students.
- Different values and perspectives are known to surface during collaborations between academics and industry partners. One example is the attitude towards disclosure of research findings. Typically, researchers and institutions are eager to publish findings whereas entrepreneurs prefer to keep IP discrete until patents are granted.
- Differences in values can also be observed in how different partners select research topics. Entrepreneurial pursuits require being customer-centric and dictated by gaps in the market, which do not always align with university or research scientist interests.
- Government and research institutions should support a more significant orientation towards encouraging and supporting entrepreneurial activity

3. Inefficient incentive structures

Current incentives and rewards structures are not directed toward com- mercialising research:

- The academic reward structure of "publish or perish" is not always conducive to the collaborative model required for successful science innovation intersecting with industry.

- Science entrepreneurship relies almost entirely on the individual's motivation to pursue the commercial pathway. In contrast, incentives from an institutional, organisational and individual level will influence a scientist's decision making process (Buzás et al., 2016).
- Intellectual property negotiations between science entrepreneurs and research institutions is often a barrier to private commercialisation by scientists independent of their institutions, due to complicated processes and differing motives of research institutions and researchers.

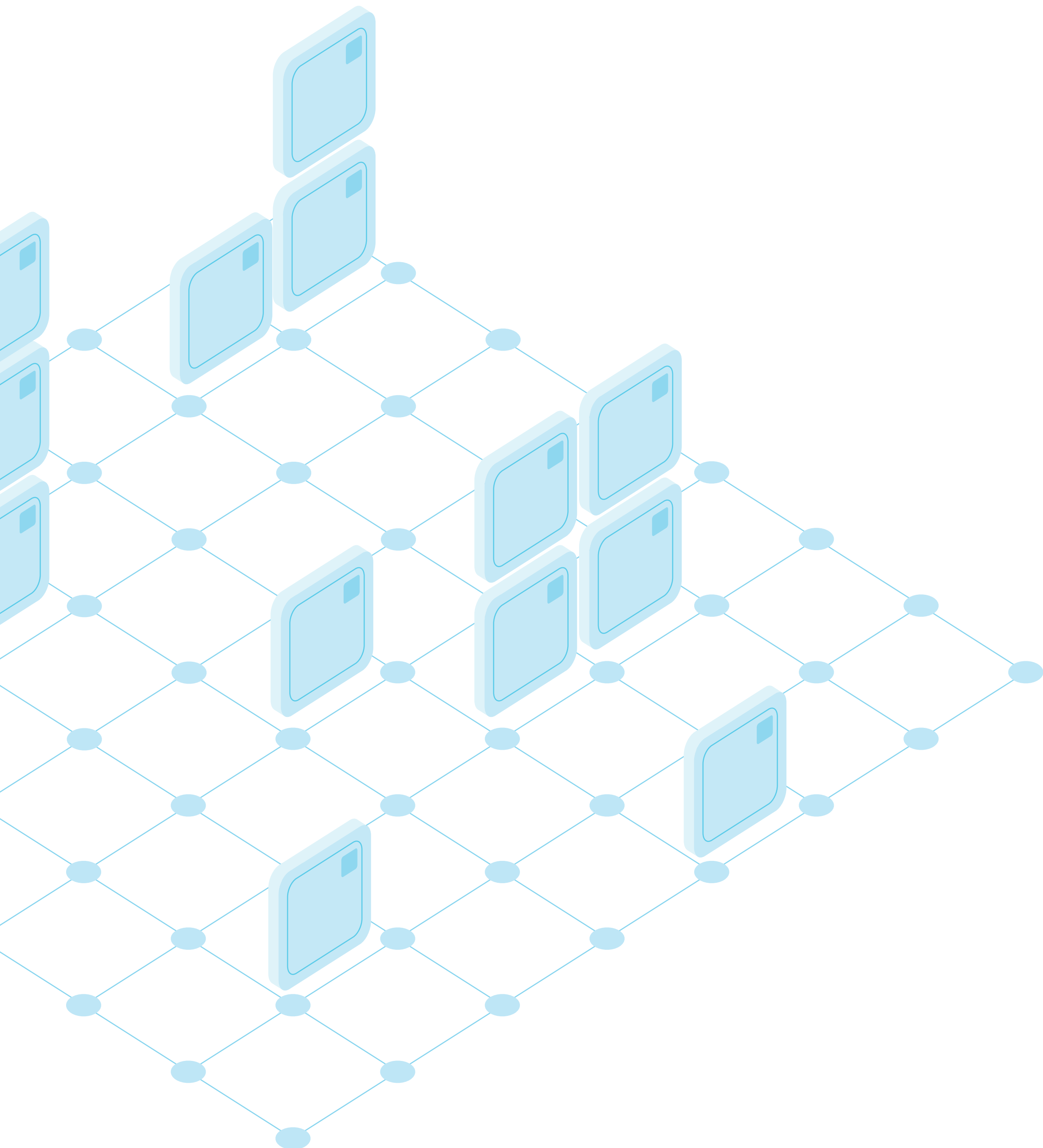
4. Barriers to scaling

By nature, science innovation start-ups face major barriers in reaching market scale due to large overheads and lengthy timelines. Currently, there is insufficient government and institutional support to foster, grow and scale science innovation overall in Australia:

- Short term government policies that prohibit consistent support are a major inhibitor to scaling science innovation ventures. Without financial support or resources – such as access to labs science entrepreneurs face greater barriers in moving from prototype to production (Harkness, 2017).
- When considering time to market, academic research does not match the pace of industry. The start-up culture to move fast and test in the market is often at odds with rigorous foundational research. It can take decades for an innovation to reach market scale, which presents a barrier to any scientist wanting to take a start-up pathway to commercialisation.
- Evaluation of entrepreneurship programs and outcomes is rare. Assessment of what is being measured as success is required to understand the type of impact being made. Measuring outputs, such as number of linkage grants, is not sufficient. A lack of evaluation means there is no clear baseline for what success looks like and the impact that is being made (Battisti et al., 2019).

Part three

Science Entrepreneurs and their Journey



Introduction

Part three describes our findings regarding science entrepreneurs and their experiences in commercialising research. It describes the key stages of the commercialisation journey and presents three archetypes of science entrepreneurship.

Why read this?

- You wish to understand the key stages of the journey of science entrepreneurship.
- You wish to understand the differences that exist between science entrepreneurs, what motivates them, and what their challenges are.

What might you use it for?

- To better understand science entrepreneurs and their journey
- To tailor supports for particular science entrepreneurs

The stages of the science entrepreneurship journey

Science entrepreneurs seem to move through common stages in their commercialisation journey when choosing a start-up as the pathway to commercialise their research. These stages are similar to any type of entrepreneurial activity, where the goal is to launch a sustainable, scaled business.

However, we found that the challenges within each stage of the journey are different for science entrepreneurs as compared to other types of entrepreneurship.

This section first describes the common pathways into start-ups for scientists. It then describes the 5 key stages of the journey, and the key challenges within each.

Pathways in

We identified 3 common paths into scientist-led start-ups:

- A career scientist or academic (research/applied scientist) who recognises a market application for their research or is motivated to see the impact of their research in the world.
- An academic or scientist with prior industry experience or knowledge of an applicable market for their research.
- A trained scientist who starts a spin-out company outside of institute parameters.
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The five stages

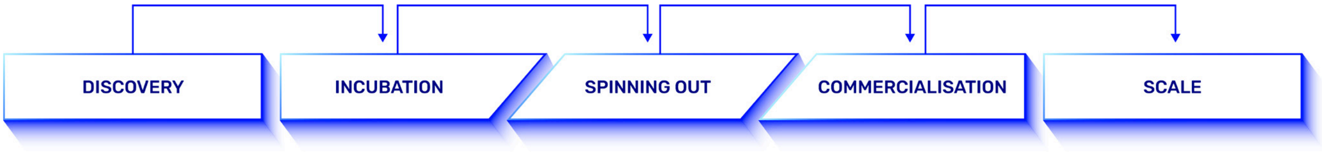


Figure 3: the science entrepreneurship journey

1. Discovery

> Scientists or researchers make a scientific discovery, consider commercialization (possibly via a range of pathways) and, in considering their options, elect to spin out a start-up

Scientists that we spoke to, tended to develop novel research either from a technical breakthrough (like a new technique or approach to solving a science problem), or from a market insight (identifying an unmet need in the market, and applying scientific knowledge towards a solution), and seek to commercialize this innovation.

The consideration to commercialise research is triggered by:

- Outside influence; demand from a potential customer, or interest from a proactive investor or business catalyst.
- Inside influence; encouragement from the institution or colleagues who are aware of the potential of the innovation.
- Institutional changes; where funding for a project changes or is cut, or where a scientist is asked to move on to a new project.
- Personal drive; the need to continue the work, or to see work through to impact outside of research circles.
- Once a decision to commercialise research has been made, scientists then begin to seek pathways to commercialisation, and enter an incubation stage.

2. Incubation

> Some scientists commit to the start-up commercialisation pathway, and formalise their commercialisation attempt.

Scientists who chose this pathway begin to become entrepreneurs. They search for, enter and complete incubation programs, and begin to identify mentors.

They receive business education, and start to come to terms with the skills and effort required to translate their scientific innovation into a commercial product or service.

Teams are formed, and some team members leave or opt-out of the venture at this

stage.

Mentors are often introduced or identified at this point, and these connections become vital to the success of the venture.

For our cohort, this stage is often experienced through a formal incubation program, such as CSIRO’s ON program.

3. Spinning out

> Science Entrepreneurs establish ‘start-ups’ and attempt to reach markets.

Science Entrepreneurs feel confident enough in their venture to establish formal legal entities around their innovation.

They begin to think about raising capital, and begin negotiations with host institutions to license the intellectual property they need to commercialise their work.

They begin to search for other founders, if needed, and will look for partnerships or paths to market.

Science Entrepreneurs may leave their existing research positions at this stage, but many maintain employment whilst maintaining their venture as a ‘side hustle’.

4. Commercialisation

> Science Entrepreneurs learn how to establish and grow a business.

Science Entrepreneurs work towards establishing the business around their research or innovation. They formalise a team and business processes, and begin to search for and obtain their first customers.

They often receive funding, either from venture capitalists or from grants, and they use this funding as ‘runway’ for their business.

A first round of employees may be brought on, who are not equity partners.

Science Entrepreneurs engage in further market and customer research, and further iterate early versions of their product or service based on market feedback.

5. Scale

> Science Entrepreneurs find product-market fit and enter a growth phase.

The business matures; the science innovation reaches a tipping point of commercial viability and product-market fit.

The business enters a growth phase, where revenue growth triggers team growth.

Science Entrepreneurs may face manufacturing and resource scale issues, and look to grow their access to global markets.

Science Entrepreneur Archetypes

Whereas the stages of the journey are largely similar for different science innovation ventures, there are diverse types of science entrepreneurs. Through our research, we identified patterns in motivation and behaviours, as well as challenges and barriers, that indicated three distinct types of science entrepreneur: **Discoverers**, **Translators** and **Visionaries**.

These three archetypes were identified by examining the outcomes, attitudes and behaviours of science entrepreneurs.

We found that the most deterministic factors leading to experiential difference are:

- The origin of the innovation or business idea.
- The personal motivation for the type of impact science entrepreneurs wish to make.

Each of these determining factors is presented below as a spectrum.

Origin of innovation

Science Entrepreneurs come to their business idea or innovation in one of two ways:

- through a technical breakthrough; a scientific discovery that they wished to see delivered to a market; or,
- through market insight: the identification of a particular need in a market that a scientific innovation may help address.

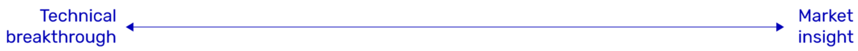


Figure 4: origin of innovation

Type of impact

Science Entrepreneurs we spoke to were motivated to start businesses by two different types of impact:

- research impact: where the science entrepreneur is driven by the belief that their scientific research would have a larger impact in the world; or,
- by systems impact: by the desire to transform or create industries, to create future employment opportunities for people like them, and to help Australia's economy transition away from extractive industries.

Figure 5: type of impact

Discovering the archetypes

These two determining factors, origin of innovation, and type of impact, were used to create a quadrant diagram against which our participants were mapped (fig. 6). Mapping our participants against these spectrums allowed us to uncover a set of three clusters, which we have labeled 'discoverers', 'translators' and 'visionaries'.

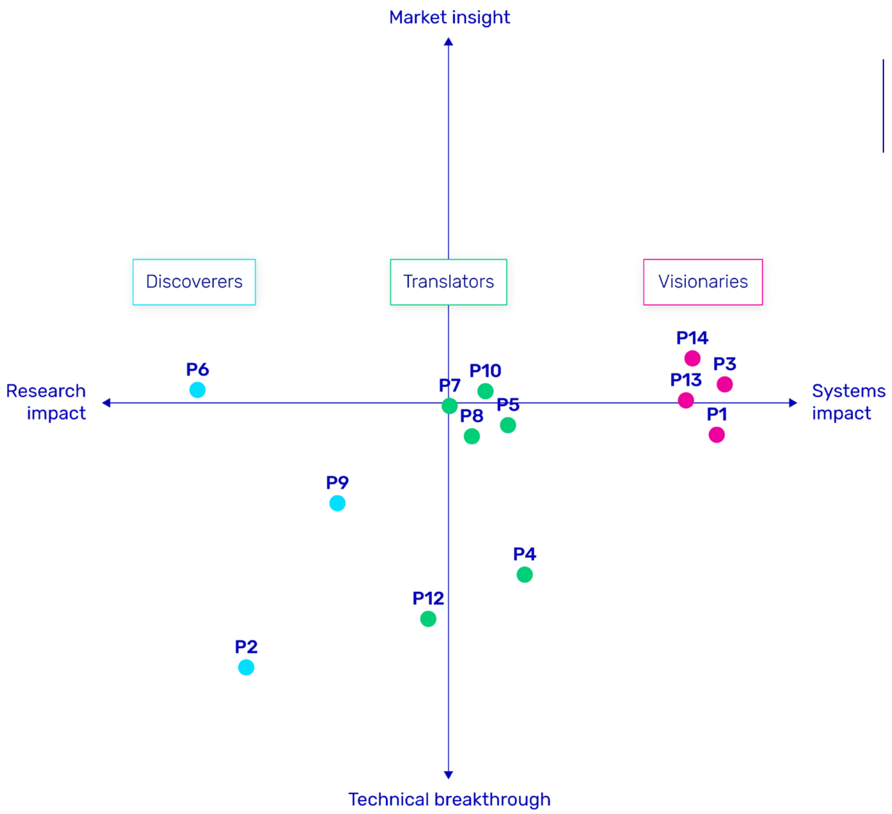


Figure 6: participants mapped across the archetype quadrant

These clusters indicate common sets of characteristics:

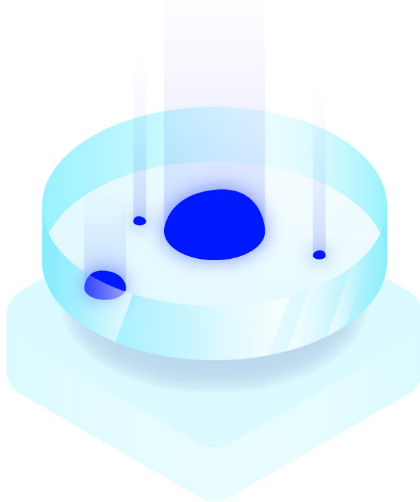
- Discoverer: a science entrepreneur who is driven by a passion for their research and the potential impact it could have in the world.
- Translator: a science entrepreneur who enjoys understanding problems that exist in the market, and connecting the dots between their scientific expertise and identified opportunities.
- Visionary: a science entrepreneur who is driven by making systemic impact, and sees scientific expertise as a competitive advantage in starting a business.

While each of these archetypes face the same systemic barriers, their individual approach and personal motivation will influence how they approach and overcome challenges.

Archetype

Discoverers

> Discoverers are passionate, experienced researchers driven by the thrill of scientific innovation.



Key Driver

Using their expertise to make new discoveries, and seeing those discoveries make an impact in the real world.

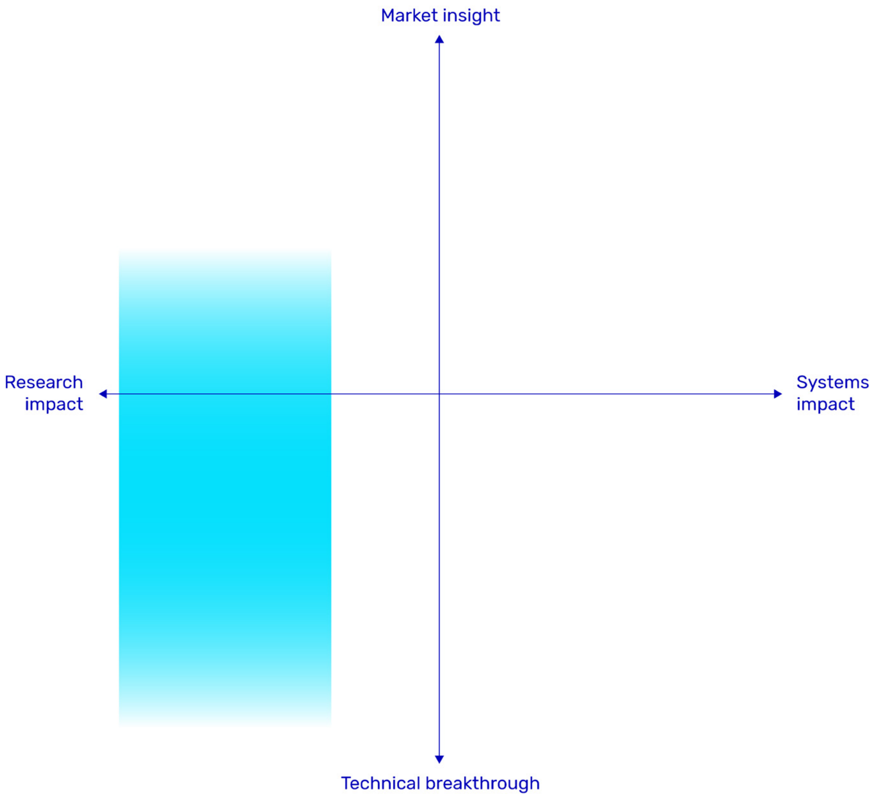


Figure 7: where the Discoverer archetype sits within the quadrant

Attitude to Commercialisation

Discoverers see:

- Commercialisation as a means to an end, if it helps to get their innovation into the world.
- Commercialisation provides a potential career path outside of research institutions.

Attributes

Discoverers are:

- Career scientists with a strong track record and reputation for quality research output.
- Focused on a particular idea that they believe will have an impact outside of a research context.
- Aware of industry needs, and view commercialisation as a way to broaden the

impact of their work.

- Skilled at winning funding in research settings, either from their own institutions or external grants.
- Least likely to persevere when faced with structural or systemic barriers.
- Less likely to have experience in commercialisation, or engaging with customers.
- More likely to return to research positions after commercialisation.

Challenges

Discoverers are:

- Reluctant to give up the security offered by research positions, and need certainty of funding or income before attempting to spin-out a business.
- Willing to attempt commercialisation, but frustrated by barriers around Intellectual Property negotiations or the incorporation process.

Success factors

Discoverers need:

- Tailored support and personalised encouragement to succeed through the discovery, incubation, and spinning out phases.

Typical journey

A discoverer is most likely to return to a research position when faced with barriers they cannot overcome during the spin-out phase.

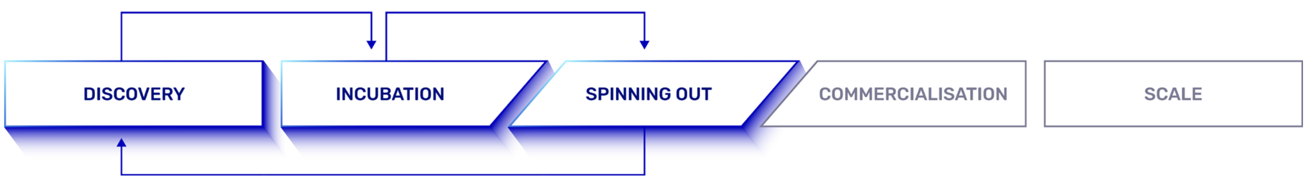
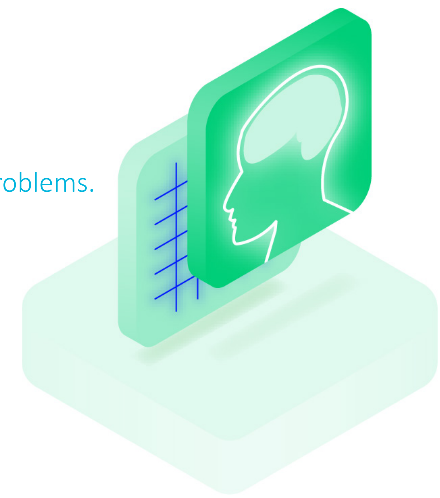


Figure 8: the typical science entrepreneurship journey for the Discoverer archetype

Archetype

Translators



| Translators apply their scientific knowledge to solve identified market problems.

Key Driver

Identifying a problem and solving it with science innovation.

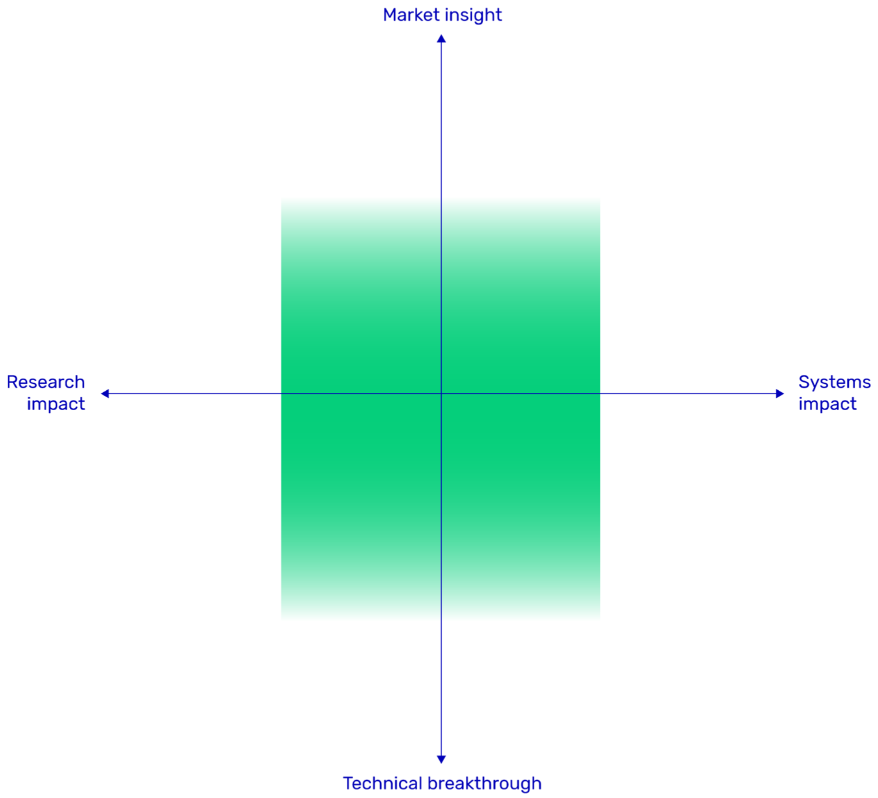


Figure 9: where the Translator archetype sits within the quadrant

Attitude to commercialisation

Translators see:

- access to markets as a way to further develop their scientific innovation.
- the value of understanding and harnessing customer insights.

Attributes

Translators are:

- researchers who have made a scientific breakthrough or recognised a market application of their research.
- tenacious and willing to persevere through the barriers faced at each stage of building a start-up.
- the 'face' of the start-up, driven to see their start-up succeed.
- willing to break from institutional constraints if it will solve the problem.
- experienced in using market insights to further develop their scientific innovation.

- able to navigate barriers, such as negotiating intellectual property terms or sourcing alternate funding.
- well connected, and can use their personal network to maintain momentum and grow opportunities.
- inspiring and will encourage others to join their venture, forming a team of co-founders and/or other researchers.

Challenges

Translators are:

- driven to succeed, but cannot achieve this success alone – they need to have the support of the right kind of team.
- dependent on fellow researchers, co-founders, and business oriented partners to fill skills gaps.
- frustrated and deflated by institutional constraints that limit forward progress.

Success factors

Translators need:

- Support that enables finding the right team and leading that team through the spin-out phase.
- to be empowered to act as champions for science entrepreneurship.

Typical journey

A translator is likely to follow through all phases of the spin-out journey and remain in the company they create.

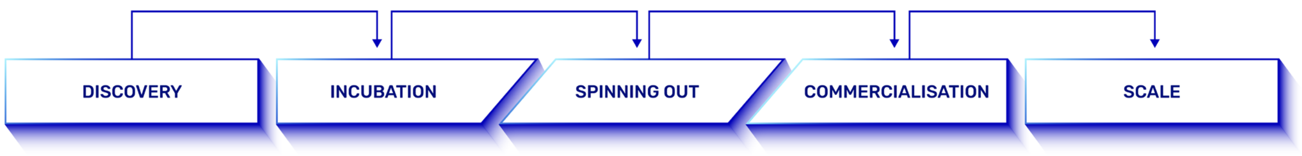
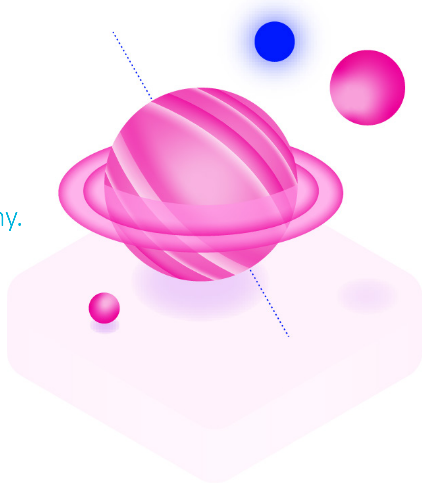


Figure 10: the typical science entrepreneurship journey for the Translator archetype

Archetype

Visionaries



> Visionaries want to create businesses that become examples for a new economy.

Key Driver

Making systems changes to increase the impact of science innovation.

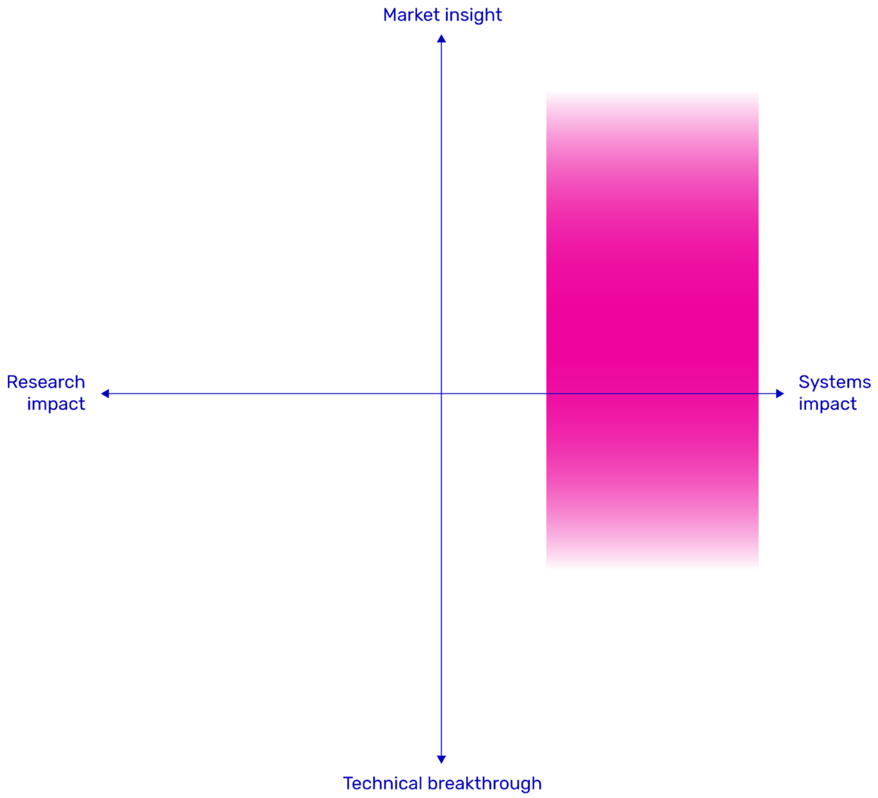


Figure 11: where the Visionary archetype sits within the quadrant

Attitude to commercialisation

Visionaries see:

- Commercialisation as way to use science innovation to transform industries
- A moral obligation to translate public-funded research to impact for public good

Attributes

Visionaries are:

- Blue-sky thinkers, who look beyond immediate success to systemic impact
- Familiar with the commercialisation process, having attempted more than once to commercialise research
- Are comfortable seeking unconventional methods to achieve a successful spin-out
- Able to take on a mentorship role for new science entrepreneurs
- Likely to pivot as they explore the industries and surrounding systems they can create leverage in

Challenges

Visionaries are:

- challenged by slow moving or bureaucratic systems in higher education or government institutions
- frustrated when others don't see the bigger picture or take their vision seriously

Success factors

Visionaries need:

- Niche technical support and funding to help them build a team and scale to impact
- A platform to tell their story to build support for systems change

Typical journey

A visionary is the most likely to make multiple attempts at commercialisation throughout their career.

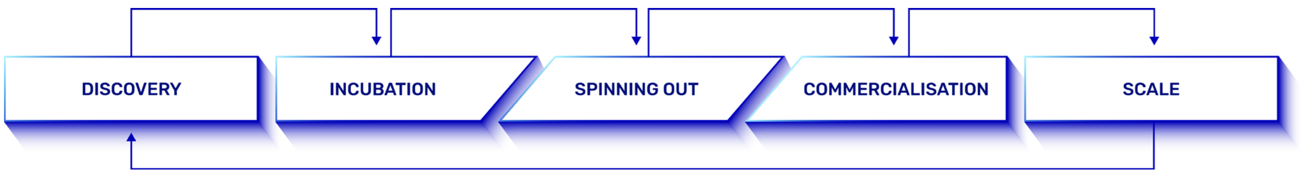
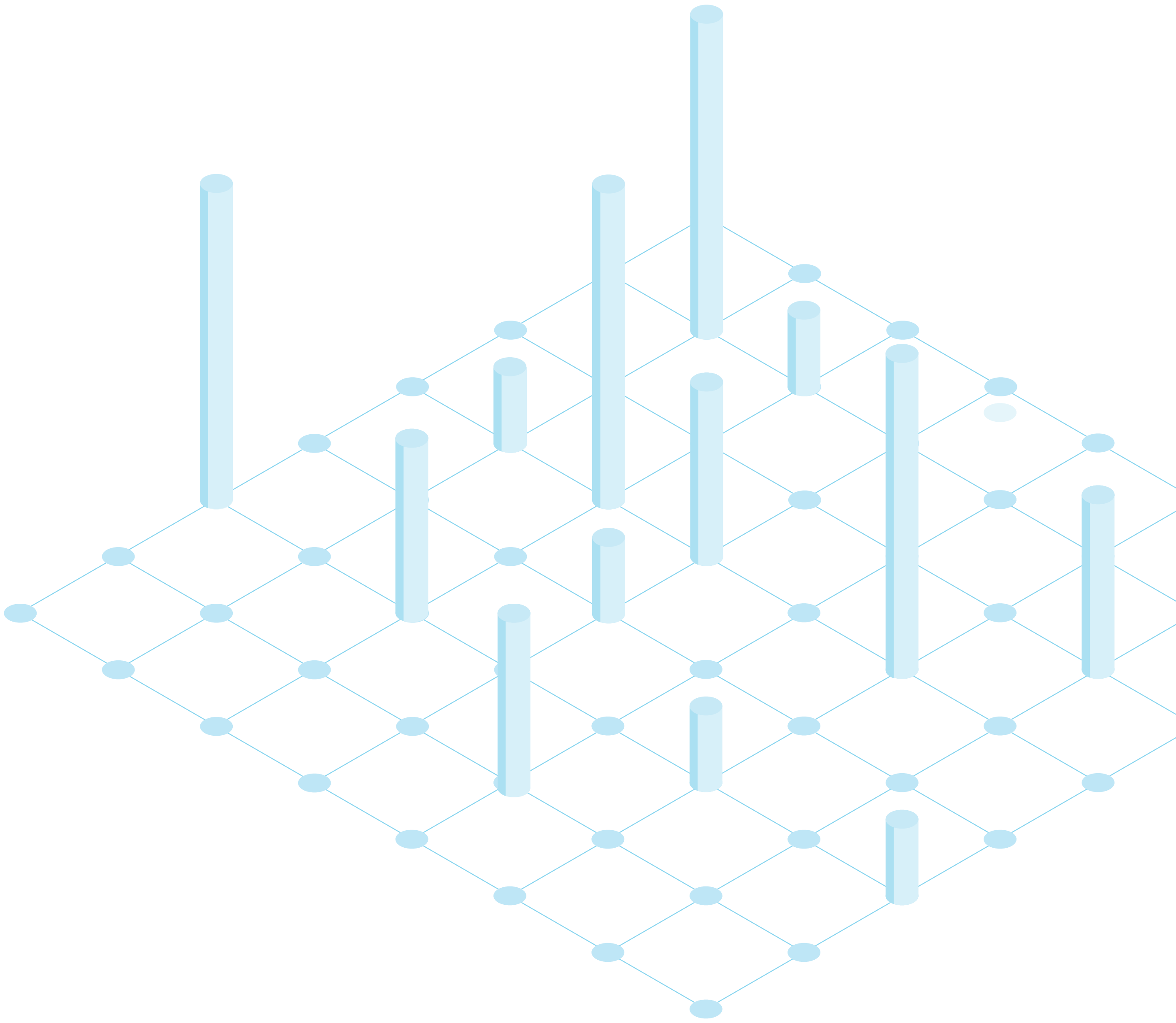


Figure 12: the typical science entrepreneurship journey for the Visionary archetype

Part four

Identifying interventions



Overview

Part four identifies four key areas of opportunity to influence the science entrepreneur pipeline and science start-up outcomes:

– Encouraging More Scientists to Commercialise
– Commercialisation Knowledge and Mentorship
– Intellectual Property Negotiations
– Influencing Investor Attitudes towards Science Innovation start-ups

Each of these opportunity areas is explored in detail here, offering key insights from our research.

Each opportunity is structured in the following way:

– **Qualitative insights** from the research, detailing the key issues at play within the opportunity area;
– **One or more case studies** from the research, replaying an anonymised version of someone's real experience;
– **Intervention points**, which are focus areas for designs and effort in order to achieve the most impact;
– **"How might we" questions** which can be used to workshop, conceptualise and design potential solutions to the intervention point.

1. Encouraging more scientists to commercialise

Systemic and cultural barriers prevent and deter scientists from pursuing commercialization pathways, particularly regarding spinning out start-ups.

Our research showed that existing barriers include:

- The perceived personal risks in leaving employment and starting a business;
- Negative attitudes toward commercialisation fostered within research institutions;
- Lack of incentives or support within research institutions for scientists interested in commercialising research;
- Lack of easily accessible demonstration of the various models for commercialization, including successful spin-outs;
- Perceived lack of pathways back (to science careers) from failure.

Addressing these barriers will encourage more scientists to attempt to commercialise their research, and will likely increase the pipeline of science entrepreneurs.

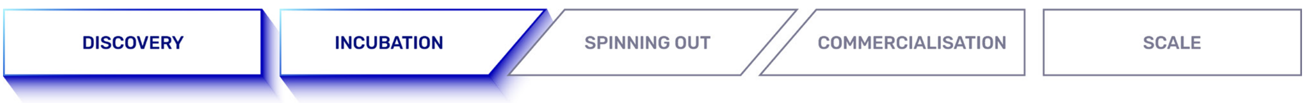
Key intervention points

- Commercially friendly organisational policies, values and reward structures
- Easily accessible success stories
- Exposure to entrepreneurial training
- Pathways back from failure

Key actors relevant to this area

- Research scientists
- Institutions
- Accelerators and other commercialisation programs
- Mentors

Where this is relevant in the commercialisation journey



Encouraging scientists to commercialise is crucial to the discovery and incubation phases – either while still working on their research during the discovery phase, or when a scientist has shown interest in commercialising research and is progressing to the incubation phase.

Figure 13: Discovery and Incubation are the relevant stages for intervention point 1.

Current experience

In Australia, few scientists go on to commercialise their research. In some research institutions, commercialisation is negatively perceived due to the current reward structure of publications and grants being the expected outcome of scientific research. As a result, efforts to explore commercialisation are not encouraged and often are unsupported within an institutional environment.

When considering commercialisation via a spin-out pathway, science entrepreneurs are taking large career risks. There is a perceived high opportunity cost and minimal demonstrated pathways back from unsuccessful attempts to commercialise, particularly for those scientists who elect to spin out start-ups.

Academic reward structures are a barrier to commercialisation

> *Institutes are missing an opportunity to foster and support the next generation of science innovators by remaining focused on current reward structures and building policies and values around them.*

Research institutions operate by a reward structure that favours academic publication of research findings and obtaining grants from research funders. These outcomes raise the profile of the institute, attracting further funding and/or students. This means organisational policies, values and priorities are often not geared towards commercialising scientific research, or encouraging scientists to start new ventures but towards publishing research, obtaining research grants and attracting students.

> *"as a degreed scientist you come to an institution or a university, and those who train you are your role models for science. And it also means there's a culture that's associated with that and a currency by which you trade. And that currency is mostly publications and grants [...] you know, that's the currency by which you're always conducting your science. And there's also a huge expectation that your creativity and your science is something that you develop as an individual."* **— Science entrepreneur**

Scientists are required to self-start

Since commercialisation opportunities are often not incentivised or encouraged, a scientist often needs to identify the pathway to spinning-out for themselves.

In our research, some science entrepreneurs acknowledged that the first step in their decision to commercialise their research felt as if they are going against the cultural grain, and it required courage to publicly express interest and intention to spin-out.

The value of the 'Accelerator Programs

Most recently, programs such as the CSIRO ON Accelerate and ON Prime and the MedTech Actuator Accelerator have provided the necessary forum for interested scientists to identify a supported pathway to commercialisation. Opportunities like these programs are integral to shifting cultural and structural obstacles that stand in the way of a scientist commercialising their research. If research institutions do not adjust their internal structures to support commercialising research, aspiring science entrepreneurs will continue to be put off by institutional obstacles and the individual effort required to make the leap to science entrepreneurship.

> *"when ON goes, there's no forum for a science entrepreneur to say 'I want to do this' because it's actually quite an embarrassing thing to do in a science organization."* **— Science entrepreneur**

> *"Market access determines the fate of one's startup, so the commercialisation strategy has to be guided by the experience. Thanks to the MedTech Actuator our startup has absolutely benefited from this."* **— MedTech entrepreneur**

Science entrepreneur's perceived opportunity cost

The "publish or perish" reward structure with academic research institutions means that it is risky for scientists to leave research careers. The emphasis on publishing research does not allow for scientists to explore the option to commercialise research without first having to make a definitive decision to leave academic opportunities behind.

> *"Once [science entrepreneurs] go into industry, and they've missed a year's worth of research, yeah, they struggle to get back into that research system."* **— Sector stakeholder**

> *"Academia is, I want to say, it's not very forgiving. So, once you're out, it's very hard to get back in. So you've got to be really sure that you never really want to come back... So it's quite a big decision. And especially at [financial investment] time, it's like, well, we're still trying to prove that this is going to work and am I going to give this up for something? So it's a big risk."* **— Science entrepreneur**

Science entrepreneurs perceive taking a break from publishing research as limiting their immediate future opportunities for receiving grants or internal promotions, and over the long term being 'locked out' of academia by losing their academic profile.

> *"even if someone kind of had the inclination to commercialise it, it takes up so much of their time that it ends up, you know, they're shooting themselves in the foot because they can't devote as much time to the research and therefore can't publish as much. And then that comes back to bite them when it comes to promotions or, you know, or anything like that."* **— Science entrepreneur**

Juggling science with entrepreneurism

Scientists that persevere through these initial barriers may be granted permission to train in entrepreneurial skills by their institute employer, however, are expected to continue their existing work simultaneously. Competing workloads inhibit a science entrepreneur's ability to fully commit time and attention to their venture, decreasing the likelihood of spin-out success and putting the scientist at risk of personal burnout.

The importance of time and support

The overall success of a spin-out company can be greatly influenced by the position an institution takes towards commercialisation. Without institutional policies or reward structures that support and encourage commercialising research, the barriers to spinning-out are even greater. Science entrepreneurs that do attempt are placed at a greater disadvantage from the beginning of their journey.

> *"your host institution, it needs to be on board [...] Without support from the host institution [...] you can't do anything, You can't commercialise your idea because the technology coming out of research is probably not at the stage yet where [...] you might get some funding,"* **— Science entrepreneur**

The culture of failures and successes in the scientific community

Pathways back from commercialisation attempts are not acknowledged or communicated within the scientific community, leaving science entrepreneurs deliberating the opportunity cost of commercialising their research and straining to maintain research positions while spinning-out.

While failure within an entrepreneurial setting is accepted as part of the expected journey to success, there is a lack of demonstrated pathways from unsuccessful commercialisation attempts back into the scientific community. Without examples of science entrepreneurs taking a commercial risk and being supported back into either scientific research or another commercial opportunity, scientist's are left to assume they risk being locked out of certain future scientific career pathways. This puts a great deal of pressure on the scientist's decision-making process and can be enough to deter a scientist from attempting to spin-out.

> *"We need to allow people to understand this concept of failure [...] allow researcher scientists to understand that failure is part and parcel of this, and that those that have failed are still in the system because they hear this rumour that if they fail they're gone, it's not true"* **— Sector stakeholder**

In contrast, research successes are commonly highlighted within the science community. Stories of successful spin-out companies are not well circulated or promoted both on a local or a global scale, yet hold the potential to shift cultural attitudes, increase interest and raise the profile of science entrepreneurship.

> *"We have lots of different honour boards, you know, that highlight in different ways scientific successes of research but we don't have that for people that have left to start their own companies and that's something we think we've got to do."*
> **— Sector stakeholder**

> *"We need the countries to know just how amazing we are as a nation, the things that we've achieved, you know, the innovations that we've done that have changed the face of healthcare globally, and they have come out of research, we need to tell the world that, we need to tell our scientists that, we need to let them know actually, if you're doing research, the only way to get it to market is to generally understand how this pathway works and get involved earlier"* **— Sector stakeholder**

Case study

Clayde’s experience navigating commercialisation in an academic environment

Clayde is a life-long academic and holds a research position at a well known university. Having completed his PhD in robotics, Clayde recognised a commercial opportunity and along with two other co-founders, set about commercialising his research.

The team received a grant to build a prototype and were successful in securing a place in a deep tech focused accelerator. The university employing Clayde gave the team permission to attend the accelerator, however, Clayde was required to maintain his research position, including teaching rounds, throughout the 3-month intensive accelerator program.

Unsure if the commercial spin-out would be a success, Clayde felt pressure to keep future options open by maintaining his research profile through regular academic publishing. Though the university had granted permission to pursue the commercialisation pathway, Clayde was wary of the opportunity cost of being ‘locked out’ of academia and felt required to juggle the competing workloads. In doing so, Clayde was unable to give his full focus to the start-up and had concerns that this would impede the chances of successfully spinning out.

Recommended intervention points

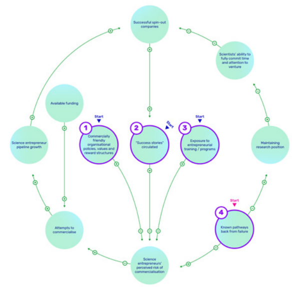


Figure 14: Thumbnail of Diagram 1. See Appendix B: Systems Loops, for detailed analysis and broader context of these interventions.

1-1 Commercially friendly organisational policies, values and reward structures for research institutes

Current state

Institutional policies, values and reward structures do not support commercialisation of research

What led to this state?

- Institutions reward structures incentivise publication, not commercialisation
- Institutions don't have a commercialisation mindset
- Institutions lack sufficient infrastructure to support commercialisation

Improving this will:

- Lower the barrier to science entrepreneurship for scientists
- More attempts to commercialise
- Increased institutional support for science entrepreneurship pipeline
- Positive shift in institutional mindset towards commercialisation

To act on this leverage point there is a need to:

Understand how to help institutions understand the benefits and their role to play in supporting commercially focused reward structures.

Questions to explore

- How might we incentivise research institute organisational culture to be more commercial-friendly?
- How might we reframe a PhD to be viewed as 4 years to create a start-up for entrepreneurial scientists?

Figure 15: Intervention point 1-1 (Diagram 1, leverage point 1).

1-2 Success stories circulated

Current state

Demonstrated success from science innovation spin-out companies are not circulated

What led to this state?

- The current focus in the science sector is on raising research profiles and attracting investment- not on promoting and supporting the commercialization of science innovation, particularly via spinning out start-ups
- Within the scientific community there is limited awareness and promotion of successful Australian science innovation spin-out company stories being circulated

Improving this will:

- Raise the profile of science innovation in Australia
- Demonstrate a successful pathway for aspiring science entrepreneurs who aspire to spin-out start-ups
- Engage and demonstrate value to potential investors
- Pique the interest of institutions not currently focused on commercialisation
- Influence a cultural shift in favour of commercialising research

To act on this leverage point there is a need to:

- Identify current Australian science innovations to celebrate
- Understand the appropriate platforms to share stories of success
- Identify the necessary audiences to target (ie. potential investors, research scientists, institutions etc.)

Question to explore

- How might we raise the profile, promote and circulate stories of science innovation success in Australia?

Figure 16: Intervention point 1-2 (Diagram 1, leverage point 2).

1-3 Exposure to entrepreneurial training

Current state

Lack of science innovation specific entrepreneurial training.

What led to this state?

- There is limited 'deep tech' and science innovation specific training
- Training is confined to specialised accelerators with limited positions available
- Most existing accelerator programs are structurally biased toward supporting digital start-ups
-

Figure 17: Intervention point 1-3 (Diagram 1, leverage point 3).

Improving this will:

- Lower the barrier to science entrepreneurship by providing a clear starting point
- Increase the likelihood of start-up success, by better equipping science entrepreneurs with the knowledge they need.
- Increase support for science entrepreneurships

1-4 Known pathways back from failure

Current state

Pathways back from spinning out start-ups are not acknowledged or communicated within the scientific community.

Figure 18: Intervention point 1-4 (Diagram 1, leverage point 4).

What led to this state?

- A culture of celebrating successes only, within the scientific community
- Limited circulation of science innovation spin-out journeys

Improving this will:

- Positive shift in scientist’s mindset towards commercialisation
- Increased institutional support for science entrepreneurship pipeline
- Positive shift in institutional mindset towards commercialisation

To act on this leverage point there is a need to:

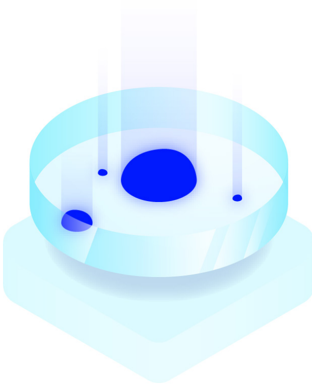
- Identify, capture and celebrate failed commercial spin-out attempts
- Create a platform to generate discourse around commercial attempts
- Provide guidance, mentorship and opportunities to science entrepreneurs who have attempted to spin-out unsuccessfully

Question to explore

- How might we improve pathways back from commercialisation attempts?

Impact by science entrepreneur archetype

Discoverer

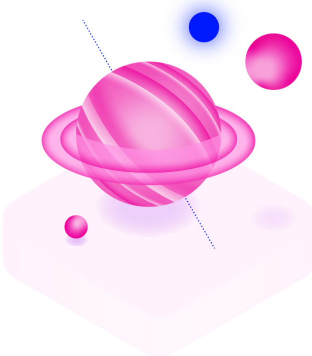


- Discoverers need the most guidance making the leap from their known field of scientific research to the unfamiliar territory of science entrepreneurship. Without clear starting points into science entrepreneurship they are likely to stay in their research position.
- Access to success stories and demonstrated pathways back will help Discoverers make the choice to attempt to commercialise their research, which they view as risky.
- Discoverers are likely to take guidance from the institutions commercialisation team, and will require external support once they have decided to uncouple from the institution.

Translator

- Translators are most likely to be inspired by success stories that show it is possible to deliver impact through science innovation.
- Translators are more likely to push back on institute terms that are unsupportive, but this can come at risk of being unpopular/ alienated within the organisation.
- Translators benefit from more institution support during the incubation phase, but are more likely to break free of institute constraints that don't allow them to make the impact they want to.
- Better commercialisation policies will keep translators in the institute longer, which is a net positive for the new venture. Translators can become easily frustrated with bureaucracy, but are more likely to benefit from access to infrastructure and labs as they commercialise.

Visionary



- Knowledge of success stories will give visionary's insight into the wider scientific ecosystem and inspire their confidence to take a leap in the direction needed and maintain their motivation.
- Visionaries are likely already outside of institutions so need friendlier institution policies that allow them pathways in. This will allow them access to 'deep tech' infrastructure they may struggle to access otherwise, but will also provide benefits to institute through cross-pollination of ideas and network building for other scientists interested in commercialisation.

2. Commercialisation training and mentorship

Better access to commercialisation training and adequate mentorship increases the likelihood of successful and sustainable ‘deep tech’ start-ups. Improving access will increase the pipeline of science entrepreneurs with lived experience and knowledge, creating individuals equipped to mentor other people who want to become science entrepreneurs, which benefits the science entrepreneur pipeline over time. Entrepreneurial training and mentoring must be of a high, expert standard and specific to ‘deep tech’.

Intervention points

- Availability of appropriate expert mentors
- Availability of deep tech specific entrepreneurial training
- Knowledge of funding landscape

Key actors relevant to this area

- Expert mentors in the field of science entrepreneurship
- ‘Deep tech’ accelerators and incubators
- Research scientists
- Science entrepreneurs

Where this is relevant in the commercialisation journey

Knowledge and mentorship are crucial during the **discovery, incubation** and **spinning out** phases, and needs to continue during and after they transition their idea to a company in the **commercialisation** and **scale** phases.

Figure 19: All stages of the science entrepreneurship are relevant for intervention point 2.

Current experience

If specialised mentorship and training for science entrepreneurs is not easily accessible, the commercialising research pathway will continue to deter curious scientists who cannot see demonstrated success of taking the initial first step.

A lack of appropriate, expert mentorship

The right advice at the right time – or lack of it – can make or break a spin-out attempt. Without accessible expert mentorship, therefore, science entrepreneurs are at a disadvantage and less likely to succeed.

To make the right kind of impact, mentorship must be continuous, fit-for-purpose and personal. This is not always reflected in the current experience of science entrepreneurs.

.

> *Look very, very carefully at the advisors and the mentors that have been put before you and work out if they are actually relevant to your sector [...] it's absolutely about domain knowledge and experience.* **— Sector stakeholder**

Science entrepreneurs need a mentor who can share their own experiences, networks, domain and/or industry knowledge, encouraging and guiding the scientist to persevere through challenges and build their own resilience. The relevant factors are the mentor's own previous experience, knowledge of the industry and or technologies, and their access to networks, giving the science entrepreneur a competitive advantage.

Often, a science entrepreneur striving to spin-out may require access to the global market – given that not all markets for science innovations are well established in Australia. Such entrepreneurs will benefit from a mentor who can guide and introduce them to potential international partnerships and customers.

Each science innovation start-up will require particular expertise. Mentors who are appropriate for one start-up may not be for another, and this is particularly true for science innovations, where technical expertise does not easily transfer. To increase the science entrepreneur pipeline, the expert mentor pipeline must also be grown.

> *You can't just assign someone a mentor and have them work, [...] I got a lot more out of it when I tracked down a local person [...] who was, like, five years ahead of me [...] any issue I've had, I just run it by them and they have a solution.* **— Science entrepreneur**

Science entrepreneurs said that mentorship was beneficial not just on a practical or technical level, but also for personal support outside of purely start-up related challenges. These two types of mentorship can come from the same person or separate people, but there is a need for both.

> *"It's not just not just an academic mentor, it's like a life mentor."* **— Science entrepreneur**

Access to relevant training and resources

Exposure to effective entrepreneurial training early in a scientist's career positively influences their attitude and interest towards commercialising research, increasing the likelihood of attempts to commercialise.

Currently such training is limited, and is largely only available in the form of incubators and accelerators such as the CSIRO ON program (which is winding down) and the Medtech Actuator. Other accelerators – including university-based accelerator and founder programs – accelerators are structurally biased toward digital start-ups,.

There is a need, therefore to re-imagining how science-specific entrepreneurial

training is accessed and distributed.

Alongside mentorship, appropriate entrepreneurial training provides content and guidance specific to deep tech and science innovation start-up challenges. In our research, exposure to training is the catalyst for the scientist making the leap to science entrepreneurship. During the research discovery phase, a mentor was often instrumental in pointing the scientist to an accelerator or other commercialisation program.

Effective training will reduce a scientist's perception of risk by illuminating what is involved in the journey to commercialisation, closing knowledge gaps – particularly regarding business acumen, understanding customers and market needs – and helping the scientist develop an entrepreneurial mindset.

> *"I'd say 90% of the [ON Accelerate] content taught was new for me. And as a scientist, I've never been exposed to business concepts. So that was all very valuable."* **— Science entrepreneur**

The current pace of many accelerator programs overwhelms participants with high volumes of information at the beginning of the program. Providing the training at the right time is as important as providing the right kind of training.

> *"Even though knowledge gaps are easy to close, they're also hard to close because you have to know which ones to close at what time, Because otherwise you're just infinitely giving people things they don't need."* **— Sector stakeholder**

Knowledge of funding landscape

One area that is relevant to all science entrepreneurs, regardless of their scientific focus, is understanding funding. Science entrepreneurs need to understand the current funding landscape, the key players and necessary networks, how to identify and access different funding sources, how to translate their innovation into investor-friendly terms, and the appropriateness of funding conditions. The funding landscape will differ for each scientific area of focus and so requires area-specific mentorship.

Currently, little of this training is available to science entrepreneurs.

Investment training available via accelerator programs is often focused on venture capital (VC) firms and developing a pitch to attract VC funding. In our research, the majority of science entrepreneurs who were exposed to training on pitching VCs found it to be ineffective or outdated by the time they met with investors.

Funding that is suitable for one start-up may not be for another. Providing mentorship specifically focused on funding challenges will support science entrepreneurs successfully navigate one of the biggest barriers they will face in attempting to spin- out.

In our research, we spoke with individuals in the sector who played an 'interpreter' role in assisting investors understand the technology and impact of the science innovation, and the financial potential on behalf of science entrepreneurs. While science entrepreneurs are typically the most passionate and knowledgeable of their company and innovation, they often require support to make a compelling case to investors in terms that translate financially. The 'interpreter' was a person who was able to help investors comprehend the innovation potential, build excitement and ultimately help the investor make an informed investment.

2. Commercialisation training and mentorship

Case study

How effective mentorship helped Lucas succeed

Lucas is an established and well published scientist. Specialising in plasmonica research, Lucas identified a market application for the research he had been working on, which led to spinning out his company. There were many mentors throughout each stage that helped Lucas navigate the challenges he faced.

During his science research career, he was encouraged by his supervisor to publish his findings and found this to be great training in clearly articulating his research.

When Lucas began his commercialisation pathway, he formed a team and was accepted into an incubation program. The team, however, withdrew, leaving Lucas operating solo and close to giving up. Encouraged and supported by the incubator co-ordinator, Lucas continued the program and was recommended a suitable mentor. The mentor was a great fit. They had extensive knowledge that filled Lucas's gaps, listened attentively, introduced Lucas to the right people- from potential customers to venture capitalists, encouraged Lucas to keep going when he faced licensing barriers with the university, and invited Lucas to continue his research and start the company via an alternative research institute when agreements with the university fell through.

When a conflict with the mentor regarding equity shares of the company could not be resolved, Lucas sought new mentors and was encouraged by the staff of his accelerator program to persevere. Lucas continued to seek mentorship in the areas needed as they arose and sees external support from others as a key success factor in his entrepreneurial journey.

Recommended intervention points

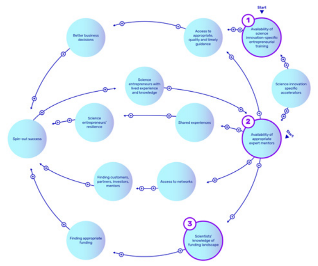


Figure 20: Thumbnail of Diagram 2. See Appendix B: Systems Loops, for detailed analysis and broader context of these interventions.

2-1 Availability of science innovation specific entrepreneurial training

Current state

Lack of science innovation specific entrepreneurial training.

What led to this state?

- There is limited deep tech and science innovation specific training
- Training is confined to specialised accelerators with limited positions available
- Existing accelerator programs are structurally biased toward supporting digital start-ups

Improving this will:

- Lower the barrier to science entrepreneurship, by equipping science entrepreneurs with the knowledge they need.
- Increased likelihood of start-up success, by ensuring science entrepreneurs are well prepared and connected.
- Increased support for science entrepreneurs through their journey.

To act on this leverage point there is a need to:

Understand how to support development of an entrepreneurial mind-set for scientists within research institutions (eg. training that can support an interested scientist who is currently blocked by institutional constraints).

Questions to explore

- How might we increase access to deep tech specific entrepreneurial training?
- How might we increase exposure to appropriate entrepreneurial training early in a scientist's career?
- How might we leverage existing accelerators to support deep tech and science innovation ventures?
- How might we deliver relevant, expert and timely advice beyond accelerator programs?

Figure 21: Intervention point 2-1 (Diagram 2, leverage point 1).

2-2 Availability of appropriate expert mentors

Figure 22: Intervention point 2-2 (Diagram 2, leverage point 2).

Current state

Entrepreneurs struggle to access appropriate, expert mentors.

What led to this state?

- Limited pool of expert mentors available
- Limited number of programs focused on deep tech and science innovation who provide access to mentorship
- Scientific innovations require guidance that is niche and nuanced, beyond 'general' entrepreneur mentorship

Improving this will:

- Grow a continuous mentorship pipeline
- Increase the chances of spin-out success by improving support for science entrepreneurs

To act on this leverage point there is a need to:

- Identify mentors with specific, relevant deep tech expertise (eg. someone seeking to commercialise a biomedical device will need a mentor who understands the specific challenges of navigating that part of the health sector)
- Understand how to design and build a network that retains and incentivises these expert mentors
- Understand how to enable a mentor's specific expertise to be accessed quickly and consistently by entrepreneurs at unpredictable moments over a long period of time.

Questions to explore

- How might we identify and build a scalable network of expert mentors?
- How might we attract, incentivise and retain expert mentors who can be accessed consistently by science entrepreneurs?

2-3 Knowledge of funding landscape

Figure 23: Intervention point 2-3 (Diagram 2, leverage point 3).

Current state

Mentors and trainers lack knowledge of funding landscape.

What led to this state?

- Limited funding opportunities for science innovation in Australia
- Limited training for science entrepreneurs of funding ecosystem

Improving this will:

- Increase likelihood of early-stage funding for science innovation start-ups

- Support more ‘deep tech’ and science innovation ventures to success

Leveraging this factor will help bridge the capital gap between science entrepreneurs and funding opportunities.

To act on this leverage point there is a need to:

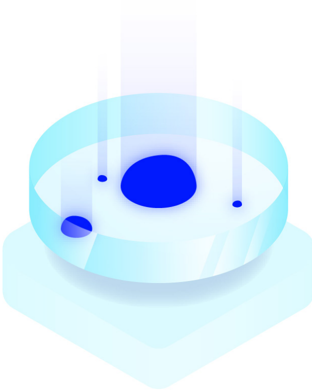
- Identify expert mentors who are experienced with financial markets and possess knowledge of the scientific sector
- Identify expert mentors who are experienced and possess knowledge of particular scientific areas (ie. finding mentors who are specifically expert in the area of biotech)
- Understand how to design and build a network that retains and incentivises these expert mentors

Questions to explore

- How might we identify and build a network of financially literate expert mentors who are able to understand scientific innovation?
- How might we train ‘interpreters’ who are able to help investors understand the science innovation technologies and scientific sector more broadly?

Impact by science entrepreneur archetype

Discoverer

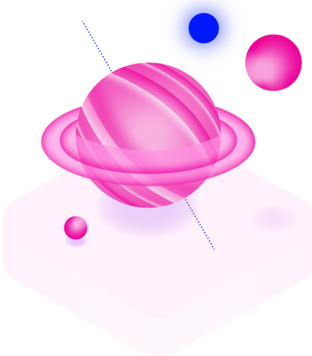


- Being the most risk-averse in their approach to commercialisation, Discoverers need training that will help them feel equipped to tackle challenges. They also require mentorship from those who have domain knowledge of their research, to help them understand the value of their work to different markets or customers.
- Mentors help Discoverers help them broaden their knowledge of funding landscapes
- Mentors help Discoverers connect with potential co-founders or team members who can address their weaknesses.

Translator

- Translators benefit from entrepreneurial training with focus on lean startup principles, business model design and customer research.
- Translators require mentorship and advice on business model related matters, and need less guidance in finding the value of their research.
- In addition to science innovation specific training, Translators are often the leaders among their team and need mentorship and training that equips them to lead effectively.
- Translators benefit from practical guidance on different types and conditions of funding and advice on making the right decisions, to boost their efforts already in motion

Visionary



- Visionaries are ambitious and harness the potential to pioneer new areas that will benefit the broader scientific community. They require mentorship from experts who can recognise and nurture their bold vision for systemic change.
- Visionaries also require thorough business training, as they may not be experienced in start-ups or in running a commercial entity.
- Visionaries will benefit from better understanding funding options.
- Visionaries are ‘innovation agnostic’, and despite having their own science innovations, will be more open than other archetypes to adopt a science innovation they were not involved in researching in order to commercialise it.
- Visionaries benefit from the networking that training and mentorship provides.

3. Intellectual property negotiations

The intellectual property (IP) related to work a researcher does as part of an institute typically belongs to the institute, not the researcher. In order to commercialise, researchers must therefore first license back the rights to their work.

This process is marred by two major issues:

- lengthy negotiations, causing researchers to lose momentum and potential customers to lose interest
- institutes offering unfavourable terms, which is both de-motivating for the researcher and increases the risk of failure by making the company an unappealing prospect for investors.

The wider community loses out when research is blocked from being applied practically in the world.

Intervention point

- Unappealing IP terms from institutes

Key actors relevant to this area

- Research institutions
- Technology transfer offices (departments within universities that deal with commercialising research)
- Science entrepreneurs
- Spin-out support service providers (eg. legal counsel)

Where this is relevant in the commercialisation journey

Intellectual Property negotiations occur during the spinning out phase of the commercialisation journey. The subsequent phases are impacted by the outcome of IP negotiations.

Figure 24: Spinning out is the relevant stage for intervention point 3.

Current experience

IP negotiations stand as one the major barriers for science innovation start-ups. Many Instiutions are currently ill-equipped to handle science innovation negotiations that will be mutually beneficial for the institution and science entrepreneur. Institutions appear to lack the foresight to recognise the value of improving their IP negotiation processes.

IP negotiations are complex and fraught

The experience of licensing intellectual property from an academic or research institute is well known to be complex, drawn out, and frustrating for the inventor. This is particularly true for science innovations that do not have a clear path to market.

For example, a new drug will need approval by the Australian Therapeutic Goods Administration and may require approval by other global regulatory agencies, such as the U.S. Food and Drug Administration and the European Medicines Agency. Regulatory pathways require significant financial investment, extensive research development and lengthy timelines.

> *The problem is that the commercialisation team doesn't do anything that isn't a small molecule, a medical device or a diagnostic I can just license to Bayer, like, anything that just isn't the simplest path to market.* **— Science entrepreneur**

The inefficiency and complexity of current IP processes can, in part, be attributed to a lack of employed staff at research institutions who are experienced and have an extensive understanding of the commercialising research process.

> *One of the challenges I think, for universities, is to employ people that are good at commercialising research and that understand; and quite often, they get people, you know, like me, that know about the sector, that understand research, don't necessarily understand commercialisation. And I think that's problematic, the resources that they have available to put into this are very, very limited.* **— Sector stakeholder**

Navigating IP terms while still employed by the research institute proved to be an alienating process for many science entrepreneurs, who reported social exclusion from colleagues and management during negotiations, which in some instances extended well beyond 12 months.

Delays in obtaining licensing can cripple a commercialisation attempt

Institutional bureaucracy often causes delays in IP negotiations. Our research showed some negotiations last several years without a resolved agreement. These delays have a profound impact on the entrepreneur attempting to spin-out. Often, an entrepreneur has built momentum and engaged interested customers or potential investors at this stage of their spin-out journey. Significant delays result in loss of interested customers and investors, and prevent the science entrepreneur from focusing efforts on developing their product and company, placing them at a market disadvantage.

> *[the IP negotiation] still hasn't been done and we're talking four years on. And we identified that instantly as the highest priority as you can imagine. So I guess that […] is an example of the, you know, having differences in expectations around that sort of thing.* **— Science entrepreneur**

All science entrepreneurs interviewed, whether they were mid-negotiation or had already obtained licensing, reported that negotiations took significantly longer than desired. In one case, the science entrepreneur missed a venture capitalist funding opportunity due to IP negotiation delays from their research institute. Many who were able to persevere and obtain favourable terms did so with the aid of third-party services accessed through their accelerator program, such as the CSIRO ON Runway services.

Unattractive terms discourage both researchers and potential investors

Research institutions seek high financial return on research investment are requesting ownership of large amounts of equity during IP negotiations, but such terms place science innovation start-ups at a serious disadvantage, ironically making institutions less likely to see any ROI at all. This is because the percentage of equity retained by start-up founders is a key consideration for venture capitalists considering investment.

> *Everybody wants that cut, but at the same time, if your cut is so large that no investor is ever going to invest, that's not going to benefit anybody. Because you know, 50% of zero is still zero. So you've got to make it attractive to an investor, but still make it attractive for everybody involved.* **— Science entrepreneur**

This common occurrence is also personally de-motivating for science entrepreneurs.

A sophisticated commercialisation department will understand the motivations of the science entrepreneur – to attract investment, successfully break into market and create sustainable revenue – and can discern that licensing terms that are only favourable to the institute decreases the likelihood of the company successfully spinning-out, an unfavourable financial outcome for the institute also.

> *We were insistent that to take that risk that we needed to have an investor-friendly licence, and it was not going to be a CSIRO government spin out. And the reason is, historically, by far, the majority of government spin-outs are not successful. And it's because government takes a huge whack of equity, and investors won't invest.*
> **— Science entrepreneur**

Institutes are not aware of the benefits of offering favourable IP terms

Institutions seem unable to see the value of aiding, not hindering, science entrepreneurs to efficiently license their research. Without this understanding, institutions are unlikely to expand their focus beyond financial gain, or to improve their capability to handle the nuances of science innovation negotiations.

Institutions need to understand that asking for too great a share of equity sets the spin- out up to fail – which means the institutions won't see any of that money anyway. As one interviewee said, "50% of zero is still zero".

Successful spin-outs raise the profile of their associated institutions. When successful science entrepreneurs develop innovations that positively impact the world, this positive impact reflects well on the institution. The institution builds a reputation as leaders

Institutions associated with successful spin-outs are perceived as leaders in promoting, supporting, and developing science innovations in Australia.

At a societal level, institutions that offer onerous IP negotiations terms are inhibiting research breakthroughs and innovations from reaching market and benefiting society. They are not just impeding the science entrepreneur pipeline, they are limiting opportunities to advance science innovation overall in Australia.

Institutions play a pivotal role in enabling – or hindering – science entrepreneurs who are striving to positively impact society by releasing research out into the world. They have a responsibility to recognise this role.

> *...entrepreneurs can't get access to their own research from university because of IP issues. You've got to simplify this whole system of getting technology out of university and noting that universities have a duty of care to the Australian population for these technologies to be in market. It shouldn't always be about deal flow, it should be about, actually, how do we genuinely try and help the Australian healthcare system?* **— Sector stakeholder**

Case study

Kane gave up on commercialising his research after licensing negotiations broke down

Kane is an established research scientist who had a rising entrepreneurial career ahead of him. Passionate about his research into genetics, on the back of a recent breakthrough, Kane was inspired to commercialise his research and see the impact of the research out in the world. Seeking opportunities to apply his research into a commercial setting, he started out by attending hackathons and was successful in winning several.

His commercialisation interest was recognised and Kane was notified of an external early accelerator program through a university contact.

Teaming up with a colleague from the research department at his university, they applied for the program and were accepted. Kane and his teammate emerged with a company idea and business plan. Given the research was undertaken at the university, all IP is automatically assigned to the university so Kane and his teammate began negotiations to licence the IP back to themselves and planned to spin out the company conceived in the accelerator program.

The negotiation process was not a smooth one. Kane found the university commercialisation process was well set up for medical devices and diagnostics, however, Kane's research did not present as simple a path to market. The university offered Kane and his teammate a 60/40 split in favour of the institute, and no financial investment into the company. Kane and his teammate did not feel the terms were feasible to attract investors, a necessary next step to get the company off the ground. Disheartened, disappointed and without licensing rights, they decided the barrier was too great and gave up on attempting to commercialise the research.

Recommended intervention point

3-1 Appealing IP terms from research institutes

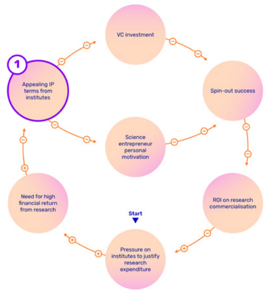


Figure 25: Thumbnail of Diagram 3. See Appendix B: Systems Loops, for detailed analysis and broader context of these interventions.

Current state

Unappealing IP terms from research institutes.

What led to this state?

- Research institutions incentivised to make revenue from licensing terms attached to commercialisation ventures
- Transfer offices and commercialisation departments of research institutions are not adequately equipped to support science innovation start-ups

Improving this will:

- Attractive terms reduce the barrier to securing investment
- More equity for the science entrepreneur and shorter negotiations motivate the science entrepreneur to continue pursuing the venture
- Greater likelihood of commercial success demonstrates value of commercialisation to institutions
- Institutions see ROI on successful commercialisation attempts, so are motivated to improve their internal IP processes, including examining the impact of overbearing IP terms

Figure 26: Intervention point 3-1 (Diagram 3, leverage point 1).

To act on this leverage point there is a need to:

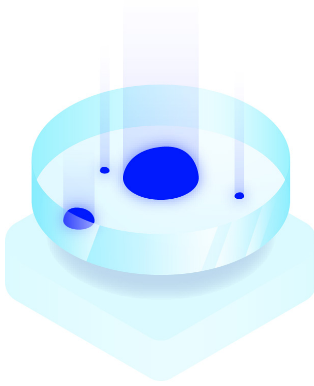
- Understand what will motivate institutions to address their IP obstacles
- Identify how to work with institutions to improve and unblock their processes
- Identify successful, repeatable support mechanisms outside of institutions that support the science entrepreneur (ie. the ON Runway services provided a science entrepreneur access to legal counsel and guidance)

Questions to explore

- How might we help institutions design better default IP terms for science entrepreneurs?
- How might we incentivise research institutions to improve their internal IP processes?
- How might we help institutions understand and take ownership over the role they play in supporting science entrepreneurs, and more broadly science innovation in Australia?

Impact by science entrepreneur archetype

Discoverer

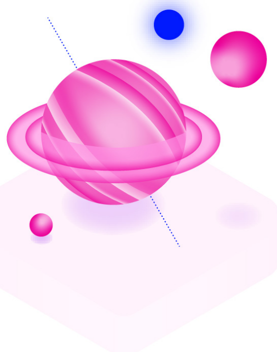


- Discoverers need advice that will equip them to feel empowered throughout negotiations. They are unlikely to know what good terms look like, and are also unlikely to push-back on suggestions from research institutions.
- They require practical guidance during this phase, but also personal encouragement to keep pursuing the venture. In particular, support by someone who has knowledge of the discoverer's particular institute will greatly help a discoverer navigate the IP process.

Translator

- Translators are determined to see licensing negotiations through, but are more likely to push-back on unfavourable terms or slow processes. They are likely to agitate for speed, but are not immune to the potential push-back from their institutions on this. Support networks that can guide the translator both practically and support them personally are important.
- Translators are likely to be less invested in a long term scientist career, which means they see a greater risk in losing equity or licensing revenue. They are likely to have higher demands on institutions, and are less likely to settle for compromises.

Visionary



- Visionaries are most likely to be deterred by the inefficiency and frustration of IP negotiations. They are more prone to 'walk away' from the venture to pursue alternate business ideas, which don't come with the equity sacrifices or the bureaucratic headaches.
- Better terms will encourage Visionaries to stick with 'deep tech' innovations beyond the spin-out phase.

4. Influencing investor attitudes towards science innovation start-ups

In order to bring their innovation to market science entrepreneurs need funding appropriate to the type of innovation they are seeking to commercialise and the support of investors to access this funding.[1] This is most important at the point in the spinning-out phase when the science entrepreneur is raising capital.

For investors, there needs to be a clear demonstration of the potential value in a science innovation start-up prior to investing. Investors need to have or be able to access the specialist skills required to understand the scientific capability of the team behind the innovation and analyse whether there is a product/market fit for investment.

Creating opportunities for investors to realise the value of science innovation also increases their motivation for an investor to crowd-in additional funding to investment vehicles designed specifically to support science entrepreneurs. Building these specialist investment vehicles that can structure appropriate funding is necessary to strengthen the overall system of science entrepreneurship.

1: In this context, appropriate means:

Right-sized: matched to the current size of the company, and the company has the absorptive capacity to spend it without making undue compromise.

Right time: funding is available at a time and for a duration that matches the type of science innovation.

Appropriate conditions: milestones and risk checks do not place undue burden on compliance.

Intervention points

- Investor perception of value in science innovation investments; and
- Evidence of science innovation investment success

Key actors relevant to this area

- Investors
- Venture Capitalists
- Angel Investors
- Impact Investors
- Other sources of capital
- Science Entrepreneurs
- Expert mentors

Where this is relevant in the commercialisation journey

These factors are most important through the **spinning-out** and **commercialisation** phase when the science entrepreneur is incorporating the company and raising capital.

Figure 27: Spinning out and commercialisation are the relevant stages for intervention point 4.

Current experience

For science entrepreneurs early-stage funding is crucial to spin-out success, but there are existing barriers to investor willingness and risk appetite that prevent this funding from being accessible to entrepreneurs.

Science innovation can be resource-intensive, and can require specialist equipment and access to the labs that house it, sometimes over a long period. For science entrepreneurs without previous commercialisation experience, structuring a viable pitch can feel like a lengthy distraction from technology development.

Conversely, for investors without specific experience in the field of science an innovation is grounded in, it can be difficult to ask the right questions required to be comfortable with the level risk inherent in the investment. Without the precedent of previous success it can be hard for investors to understand what level of risk they will be taking on.

Deep tech presents different investment risk

Given the need to set up manufacturing and production, quality control and regulatory pathways, a deep tech spin-out will have a significantly longer product development phase compared to other industries. This is in direct contrast to other technology start-ups that may pitch to an investor – such as software as a service (SASS) start-ups.

Without a physical product and the ability to launch a MVP with minimal regulatory overhead, SAAS start-ups differ in both the overhead required for research and development, as well as the length of time required to enter the market. Deep tech and medical science innovation often face lengthy R&D periods, with mandated field or clinical trials before they can be brought to market.

> *...because they can't conceive of these risks, they end up going, okay, I'll invest but you know what? It's going to be one or $2 million valuation. And in addition to that, we're going to put in all these milestone funding patches to protect your downside.*
> **— Sector stakeholder**

Investors who are operating 'business as usual', invest within the boundaries they are familiar with and applying these same criteria to deep tech investments. This type of investor does not possess the required understanding of deep tech to spark investment interest. An example is looking for the timeline for deep tech ROI to mirror other shorter-term investments, such as SAAS.

> *When you go through the local investors here and you say, 'Hey, I have a technology company here that has the potential of dominating the world.' They're like, 'Great, how much revenue have they had?... When are they going to turn a profit?* **— Sector stakeholder**

The lengthy time to market acts as a deterrent to many investors who are seeking a shorter term return on investment and requires a particular attitude and understanding on the investor's behalf. But the payoff from a successful science or medical investment can be immense.

Investors can be convinced

Our interviews with investors in the deep tech space, showed a positive attitude towards peers in the science entrepreneurship community. An interested deep tech investor is comfortable with the risks associated with science entrepreneurship, is able to assess the skill of the scientific and market impact of the innovation and is comfortable with the timelines involved.

> *One of the big structural barriers that we have in Australia is our culture and our philosophy and our ease of understanding commercialisation and wanting to deal with it.* **— Sector stakeholder**

There are natural barriers that exist for investors unfamiliar with scientific investment and are uncertain about the perceived credibility of science entrepreneurs. Programs such as the CSIRO ON Accelerate and ON Prime were successful in helping to break down this initial barrier by creating an initial sense of trust. CSIRO being a well-known research institute eased investor doubt.

> *When you bring them a deep tech deal, [investors] don't understand. And because they don't understand that, they don't take the risk.* **— Sector stakeholder**

Those investors willing to invest are those who can see past the barriers presented to the impact to be made. This is currently a narrow pool, as stories highlighting deep tech spin-out company successes are not currently widely and publicly promoted.

Using stories of success to bring attention to and positively highlight deep tech investment outcomes is crucial to piquing interest more broadly overall.

> *The shift will only happen if a collection of institutions are going, this is what we're going to do. And then the whole market goes, Oh my God, why are you doing that? We got to look into this. When you create that FOMO, that's fantastic.* **— Sector stakeholder**

There isn't appropriate funding

The current funding system for science innovation is experiencing a funding or capital gap, which is the gap between the available capital and the capital necessary for startups to succeed. The current funding system requires science entrepreneurs to jump from contract to contract, or to "grant strap" by using selective grand funding to stretch to commercialisation activities.

> *The problem in Australia [...] is a capital gap. We have a huge, huge capital gap problem. And it's so severe, it is so severe the universities in Australia are selling our technology to [international] governments* **— Sector stakeholder**

There is a lack of targeted investment vehicles that provide the appropriate funding, but also offer other value-add services to support science entrepreneurs at this critical stage of commercialisation. Investors can provide funding but also possess expertise in corporate development and go-to-market strategies that science entrepreneurs may not. Building appropriate funding mechanisms requires the design of new vehicles for capital that are sensitive to the needs of science entrepreneurs.

Case study

Paulina’s experience finding investment funding

After several years working as a civil engineer, Paulina decided to do a PhD in chemical engineering. Coming to academia with industry experience, Paulina had planned to commercialise her research findings from the beginning. After completing her PhD, Paulina partnered with fellow researchers and together they successfully completed incubator and accelerator programs based on her research.

After successfully licensing the IP back to themselves from the university, Paulina and her co-founders launched their company and secured a grant to build a prototype.

After several rounds of unsuccessful pitches to venture capitalists, Paulina and her co-founders realised the investment time frames were not aligned with the time needed to refine the product and get it to market. Unable to overcome this hurdle with venture capitalists, Paulina and her team turned their focus to angel investors and family offices, who were more open to the type of investment Paulina’s company required.

Aware of the crucial stage of spinning out the company and wanting to make the right decision, not a rushed decision, Paulina and her team did a round of funding from family and friends to buy more time in securing the right type of funding. During this time, Paulina made a connection with an investment fund that the team felt were suitably aligned to the company’s funding needs.

Recommended intervention points

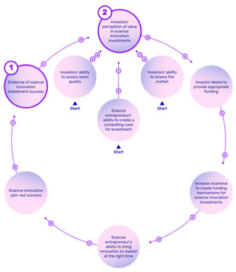


Figure 28: Thumbnail of Diagram 4. See Appendix B: Systems Loops, for detailed analysis and broader context of these interventions.

Figure 29: Intervention point 4-1 (Diagram 4, leverage point 1).

4-1 Investors have evidence of science innovation investment success

Current state

There are few evidence-based case studies of science innovation investment success.

What led to this state?

- Changing funding environment means no consistent funding to tell compelling success stories
- Long tail of science innovation investments means there are few stories to tell

Improving this will:

- Encourage investors to fund science innovation start-ups
- Increasing the opportunity for science entrepreneurs to continue their venture

To act on this leverage point there is a need to:

- Circulate successful deep tech spin-out companies among research institutes and investment circles to raise the profile of deep tech companies and help to demonstrate to investors the investment risk payoff.
- Evaluate and measure the impact of science innovations in order to track and build an evidence base of demonstrated value.

Questions to explore

- How might we best demonstrate the value of science innovation to investors?
- How might we build an evidence base of science innovation impact?
- How might we create an accessible platform that centralises information about emerging science innovations?

4-2 Investors see value in science innovation investments

Current state

Scientists misjudge the role, risk-factors and KPI's of investors and as such are ill-prepared to raise funds.

What led to this state?

- Lack of funding toward deep-tech innovations with seemingly favoured options towards digital startups
- Inadequate training for science entrepreneurs to be able to make the case to investors

Improving this will:

If scientists are able to demonstate commercial promise, experienced team and financial retrun on their technology;

- More funding will flow to these kind of ventures
- Higher chance for deep tech and science innovation start-ups to commercialised
- Investors are more likely to open their doors to science entrepreneurs
- More serial science entrepreneurs contributing to the system

To act on this leverage point there is a need to:

- Understand how to develop sophisticated investor community that sees value in science innovation
- Understand how to better support science entrepreneurs in finding a common language/understanding with investors (eg. a science entrepreneur may be able to speak to the technology and potential impact, but not the financial sense that the investor needs to understand)
- Understand how to match science entrepreneurs with the right investors at the right time

Questions to explore

- How might we reach investors and help them recognise the value of science innovation investment?
- How might we develop and foster a network of sophisticated investors who are accessible by science entrepreneurs?
- How might we support science entrepreneurs to communicate their innovation in financial terms?

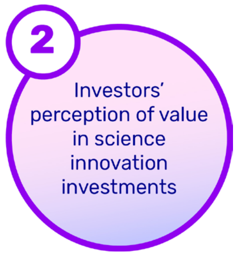
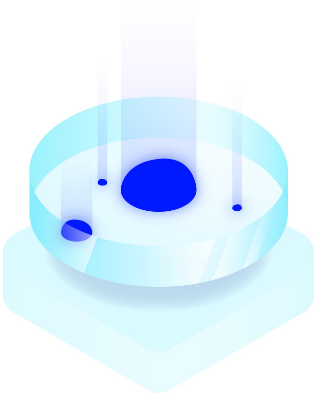


Figure 30: Intervention point 4-2 (Diagram 4, leverage point 2).

Impact by Science Entrepreneur Archetype

Discoverer

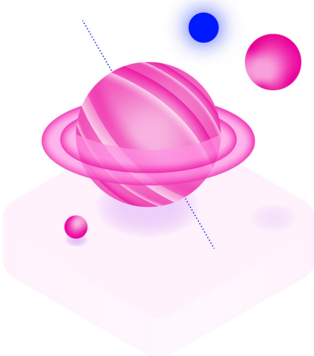


- Discoverer's have the lowest appetite for risk and need the most certainty of funding in order to take the leap into science entrepreneurship.
- More proactive investors ie. investors approaching them, will help them build up confidence and "allies" to take the leap and push through barriers. For a Discoverer, a positive investor could be a catalyst to pursuing the venture.

Translator

- Translators will have more options on how they seek funding (ie. less grant funding and short contract jumping) and therefore more time and focus to put toward their team and venture
- Proactive and positive investors strengthen a Translators case when negotiating IP terms from institutions.

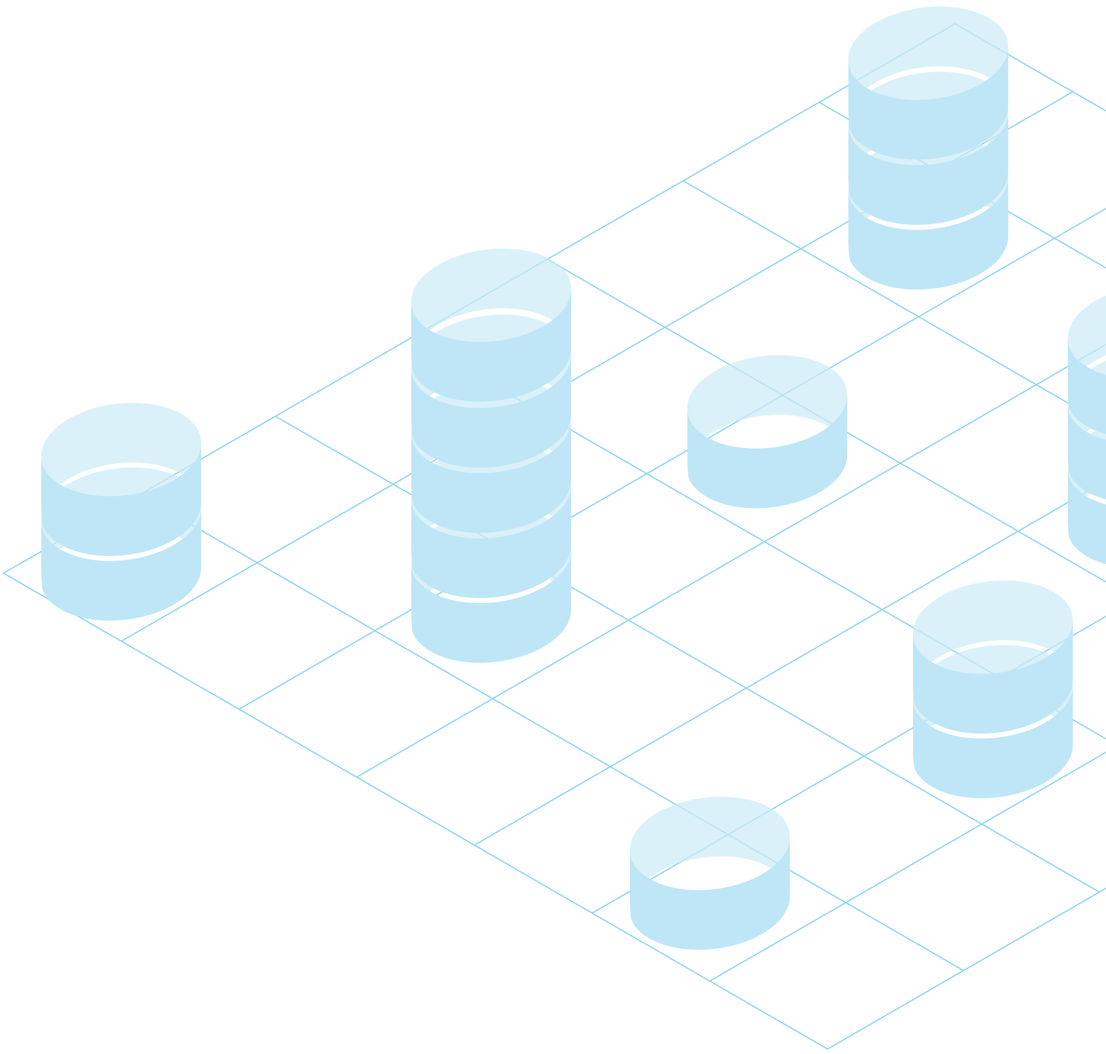
Visionary



- Visionary's who are serial entrepreneurs will have bigger networks to draw from and desirable prior experience from an investor's perspective. A team featuring a visionary will increase investment opportunities.
- Successful Visionaries are likely to become investors. Improving current investor attitudes is likely to trigger a virtuous cycle of future investment sources, as more ventures become successful.

Part five

Next steps



Recommendation: Designing Interventions

Our research has identified four main opportunity areas to increase the science entrepreneur pipeline, improve the experience of research commercialisation for science entrepreneurs, and in supporting science-based start-ups to success. These are:

1. Inspire and enable scientists to access commercial industry pathways
2. Inform through industry-led training and tailored mentorship the elements of commercialisation
3. Intellectual property foundations including global patent positioning and inventor access
4. Fundamentals of investment capital and required alignment for investor consideration

Within these opportunity areas, we have identified a number of 'leverage points'. Each of these presents an opportunity for further research, collaboration and design work to improve outcomes.

We recommend prioritising and working with the following leverage points:

1. Developing more **commercially friendly policies and incentives** with research institutions, to encourage more scientists to attempt commercialisation, including **developing pathways back** into research institutions for those science entrepreneurs that fail.
2. Collating and making available (digitally) **success stories** around science entrepreneurship to help encourage risks and change attitudes, with two audiences in mind: scientists and investors.
3. **Improving access** to science-innovation specific entrepreneurial and business **training**, including likely funding pathways and more nuanced forms of mentorship, for scientists – particularly those whose institutions do not have an incubator program.
4. **Designing intellectual property guidelines** that can help research institutions understand what 'good' looks like, and can empower science entrepreneurs in negotiations.
5. Influence investor and funder attitudes by **creating publicly accessible resources** and stories of success around the return on investment for science entrepreneurship.

Each of these intervention points presents opportunities for innovative thinking and collaboration, and each will contribute positively towards better commercialisation outcomes.

Recommendation: The Funding Cliff

Figure 31:
The funding gap for science entrepreneurs leaving incubation

When looked at together, many of the opportunity areas and intervention points identified in this research point to the 'danger zone' of post-incubation and pre-investor funding.

There is a need to **attract more scientists** to commercialise, and to **help those scientists learn about business.** However, after intellectual property rights are negotiated, there remains a period of time where businesses need to develop and mature before they are able to attract investor funding.

Whilst **helping investors understand the value** of science-based start-ups is important, there is also further need to support these ventures to become "investible".

Ventures founded on science innovation take longer to get to market and are therefore slower to provide evidence of market uptake. Similarly, iterations and improvements of a science-based product may take much longer than other types of product development.

Science start-ups therefore take longer and need further support to become attractive investments.

The "funding cliff" speaks to the **gap in funding supports for ventures** that are looking to mature to a point of investability.

We recommend exploring ways of unlocking resources for ventures beyond incubation, so that they may develop to the point of being attractive to investors.

Recommendation: Further Research

Our scope of research focused on the experience of science entrepreneurs, and those who support them.

There are opportunities to further explore:

1. **Investor attitudes**, including barriers to investment in science start-ups.
2. Commercialisation policies, processes and opportunities within the **tertiary education** sector.

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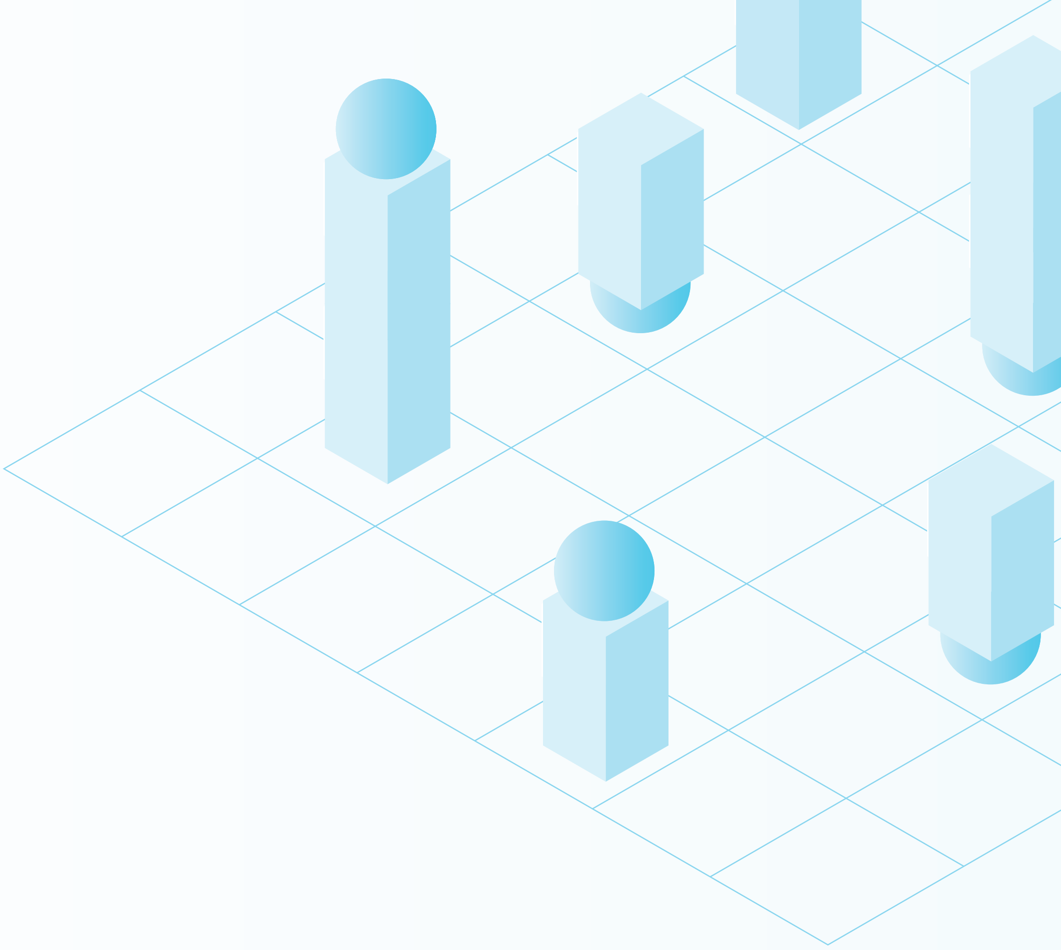

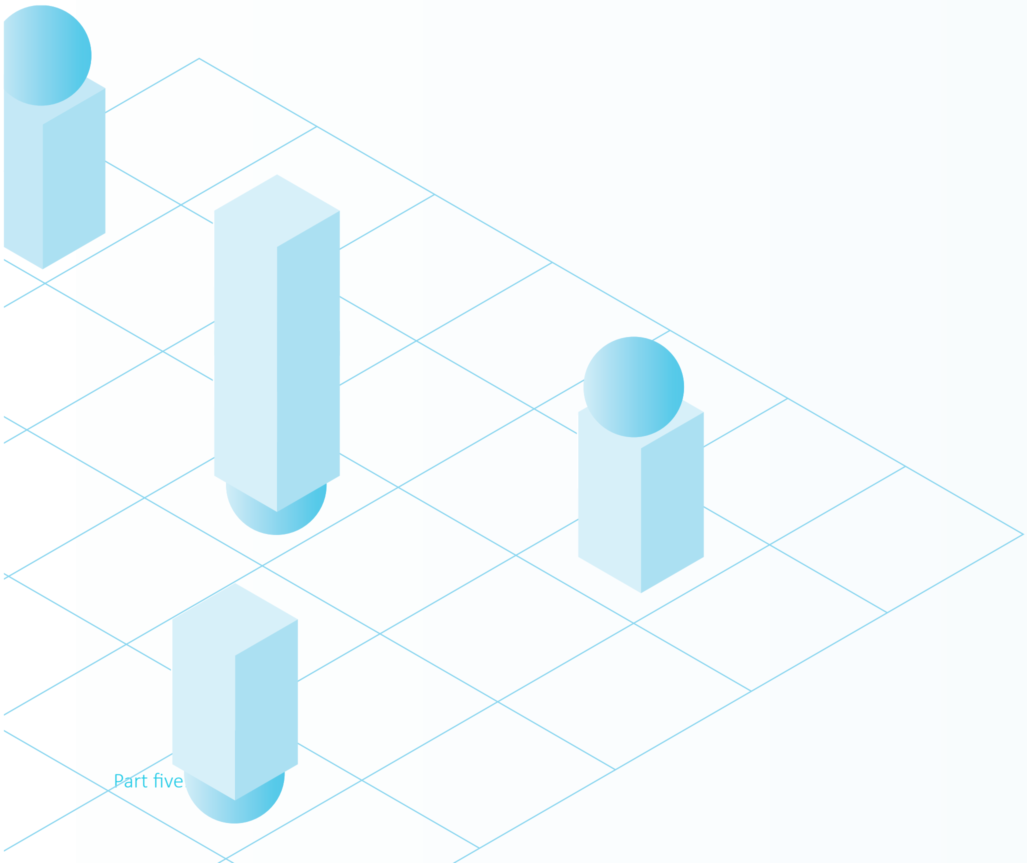

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Appendix A

Research methodology

Participants

We interviewed 10 science entrepreneurs (6 male, 4 female) with a range of experiences with commercialisation, at different stages of their spin-out journey.

- 8 out of 10 participants had started their own business. The two that hadn't yet launched a business planned to do so in the following 12 months.
- All participants had been involved with an accelerator or incubator, and 9 of those were involved with CSIRO's On Prime and/or On Accelerate Program. All participants cited their involvement in these programs as a key catalyst to starting their business.
- 4 out of 8 businesses had received pre-seed or seed funding.
- 6 out of 10 participants were still salaried in research institutions like CSIRO or Universities.
- Businesses had between 0 and 5 salaried employees.

Interviews with science entrepreneurs focused on understanding:

- Their background, motivations and drivers for starting in science and then moving into entrepreneurship.
- The journey that they had been on to date in their science career, including any experience with commercialisation.
- Their experiences of attempting to commercialise research, including barriers and enablers.

The journey from scientist to science entrepreneur, translating scientific technologies and innovations to revenue creating businesses is complex, has multiple influencing factors and involves many key actors across several years. To complement our understanding of the science entrepreneur journey, we interviewed 8 individuals who are involved directly with science entrepreneurs or are in the research and commercialisation sector more broadly.

These participants included:

- Founders and staff of incubators and innovation programs
- A private consultant in innovation and start-up development
- A professor of innovation; and,
- Venture Capitalists

Interviews with sector stakeholders focused on understanding:

- The current state of funding and support
- The key actors, players and organisations involved in commercialising scientific research
- The attributes that science entrepreneurs possess that set them up for success,

and the common challenges they face
- The opportunities that exist to improve outcomes for science entrepreneurs

Research Questions

Our project has one guiding question:

To help answer this question, we have a series of sub-questions to guide our work, and against which we report in this document.

→ *How might we unlock the resource pipeline to science entrepreneurship to create the industries of the future?*

The guiding questions are:

1. Who is a science entrepreneur and what are their characteristics?
2. What is the current experience of science entrepreneurship?
3. What are the systemic, personal and circumstantial barriers and enablers to science entrepreneurship success?
4. What are the levers for change that might improve outcomes for science entrepreneurship?

Appendix B

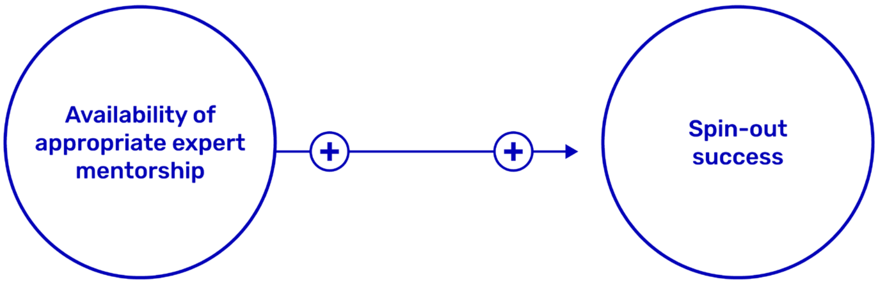
Systems Loops

How to read a systems map

Systems maps show causal relationships situated within a broader system; they don't show steps in a process.

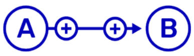
The large circles represent factors in the system. Factors, such as 'availability of appropriate mentorship' have influence over other factors. These lines of influence are shown by the arrows. The direction of these arrows dictates the reading direction (read towards the arrowhead).

The ⊕ and ⊖ symbols should be read as 'increased (likelihood) of factor' and 'de-creased (likelihood) of factor', respectively. For example:

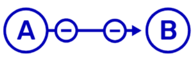


This should read 'increased availability of appropriate mentorship leads to increased likelihood of spin-out success'.

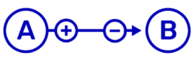
To extrapolate:



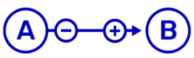
This should be read as: "if there is an **increased** likelihood of factor A, then there is an **increased** likelihood of factor B."



This should be read as: "if there is a **decreased** likelihood of factor A, then there is a **decreased** likelihood of factor B."

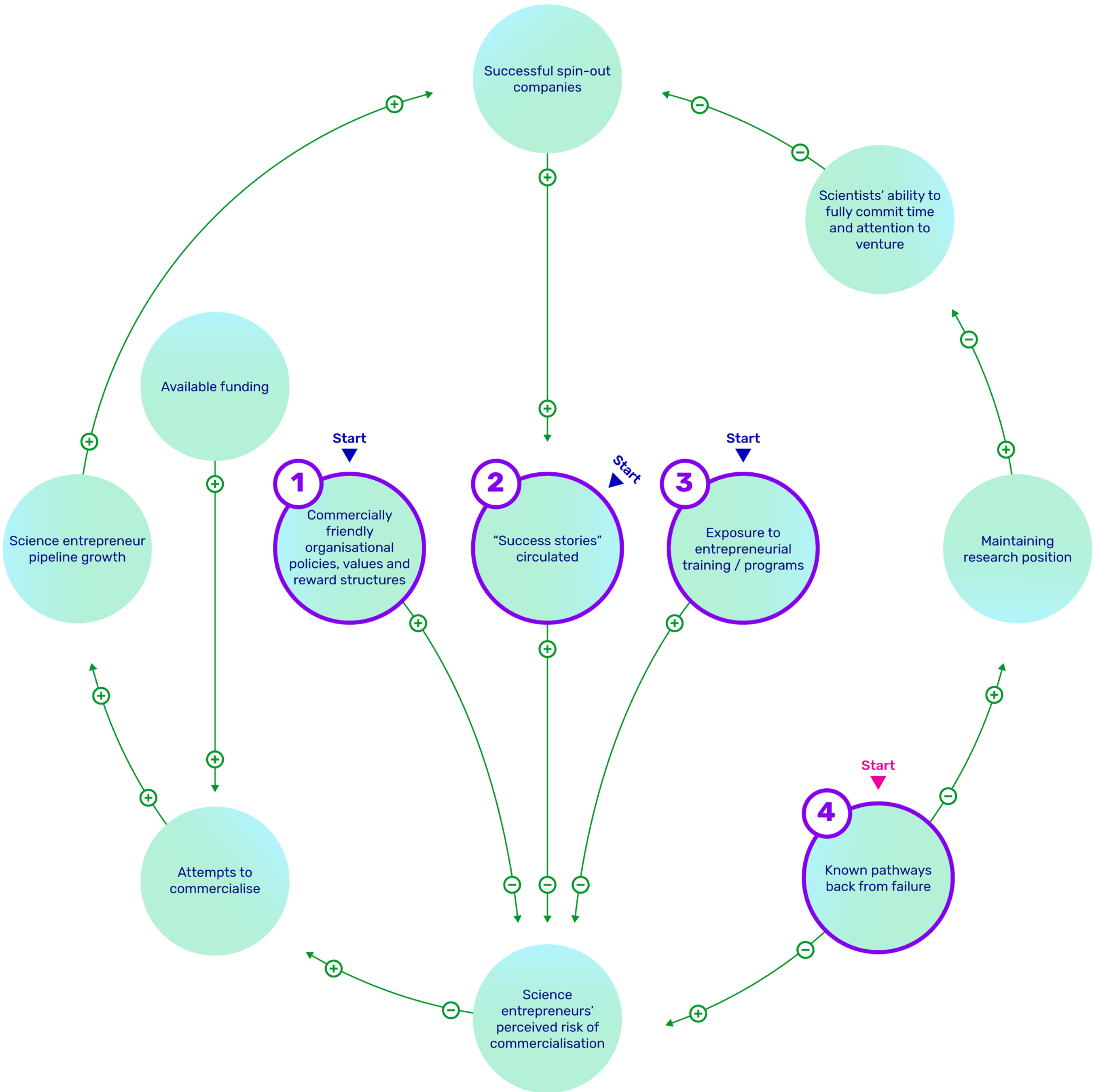


This should be read as: "if there is an **increased** likelihood of factor A, then there is a **decreased** likelihood of factor B."



This should be read as: "if there is a **decreased** likelihood of factor A, then there is an **increased** likelihood of factor B."

Diagram 1: Encouraging more scientists to commercialise



Circulating stories of success will decrease scientists' perceived risk towards commercialisation.

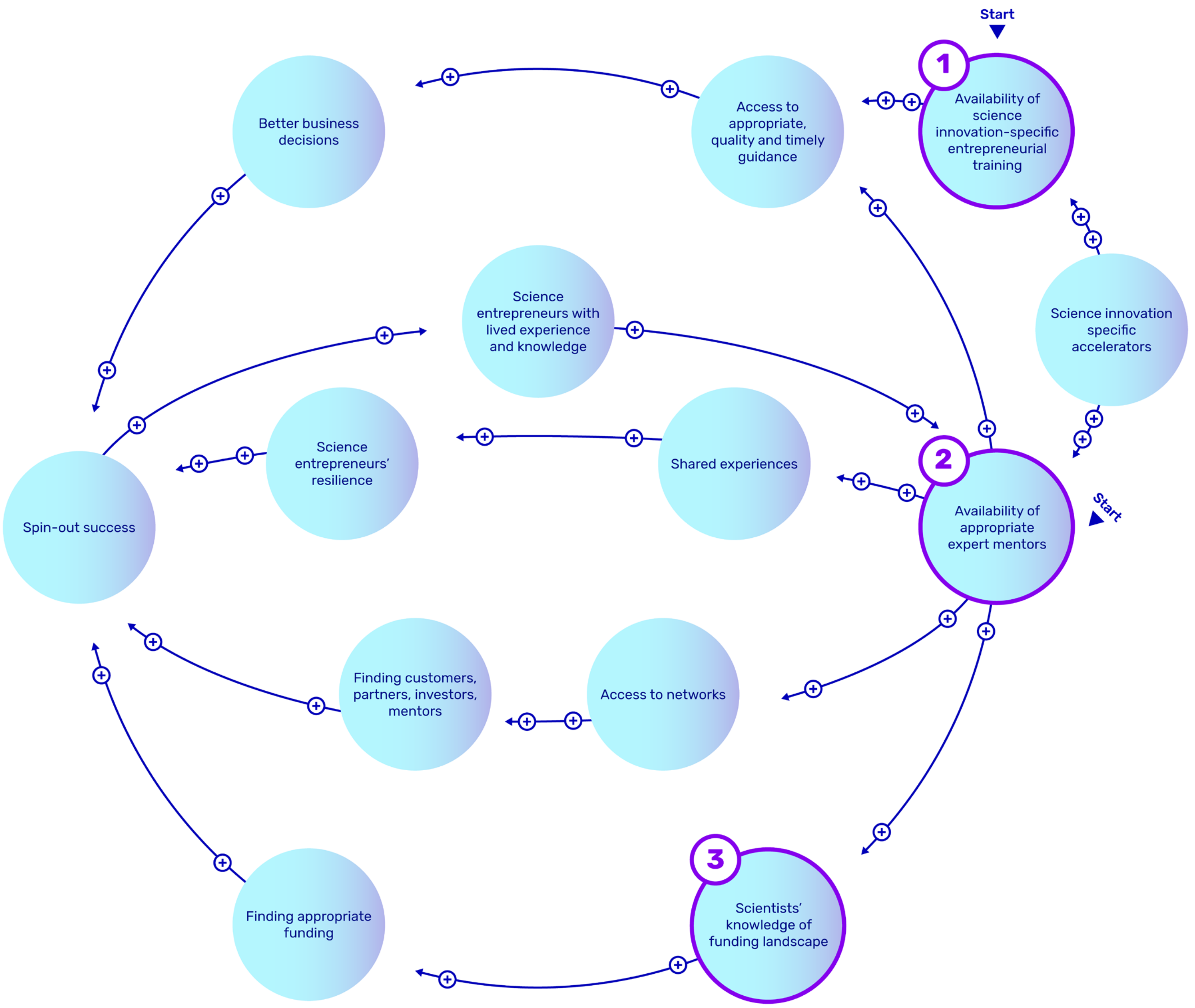
Diagram summary

The statements within circles either increase [+] or decrease [-] the likelihood of the factor(s) it is connected to.

Begin reading this loop from the blue arrow:

- **Commercially friendly organisational policies, values and rewards structures** 1, **success stories circulated** of spin-out companies 2, and **exposure to entrepreneurial training/programs** 3 decrease the likelihood of a scientist's perceived risk of commercialisation
- A decrease in the likelihood of a scientist's perceived risk of commercialisation increases the likelihood of **attempts to commercialise**
  - An increase in **available funding** increases the likelihood of attempts to commercialise (see intervention 4: Influencing Investor Attitudes towards Science Innovation Start-ups for more detail on funding availability)
- An increase in **attempts to commercialise** increases the likelihood of science entrepreneur pipeline growth
- An increase in the **science entrepreneur pipeline growth** increase the likelihood of successful spin-out companies
- An increase in **successful spin-out companies** increase the likelihood of success stories circulated
- An increase in **success stories circulated** decreases the likelihood of a scientist's perceived risk towards commercialisation
- A decrease in **known pathways back from failure** 4 increases the likelihood of a scientist's perceived risk towards commercialisation
- A decrease in **known pathways back from failure** 4 increases the likelihood of a scientist maintaining their research position
- An increase in the likelihood of a scientist **maintaining their research position** decreases the scientist's ability to fully commit time and attention to their venture
- A decrease in a **scientist's ability to fully commit time and attention to their venture** decreases the chances of building a successful spin-out company
- A decrease in **successful spin-out companies** decreases the number of success stories circulated
- A decrease in **success stories circulated** increases the likelihood of a scientist's perceived risk towards commercialisation

Diagram 2: Commercialisation Knowledge and Mentorship



→ *Increasing expert mentors will improve outcomes.*

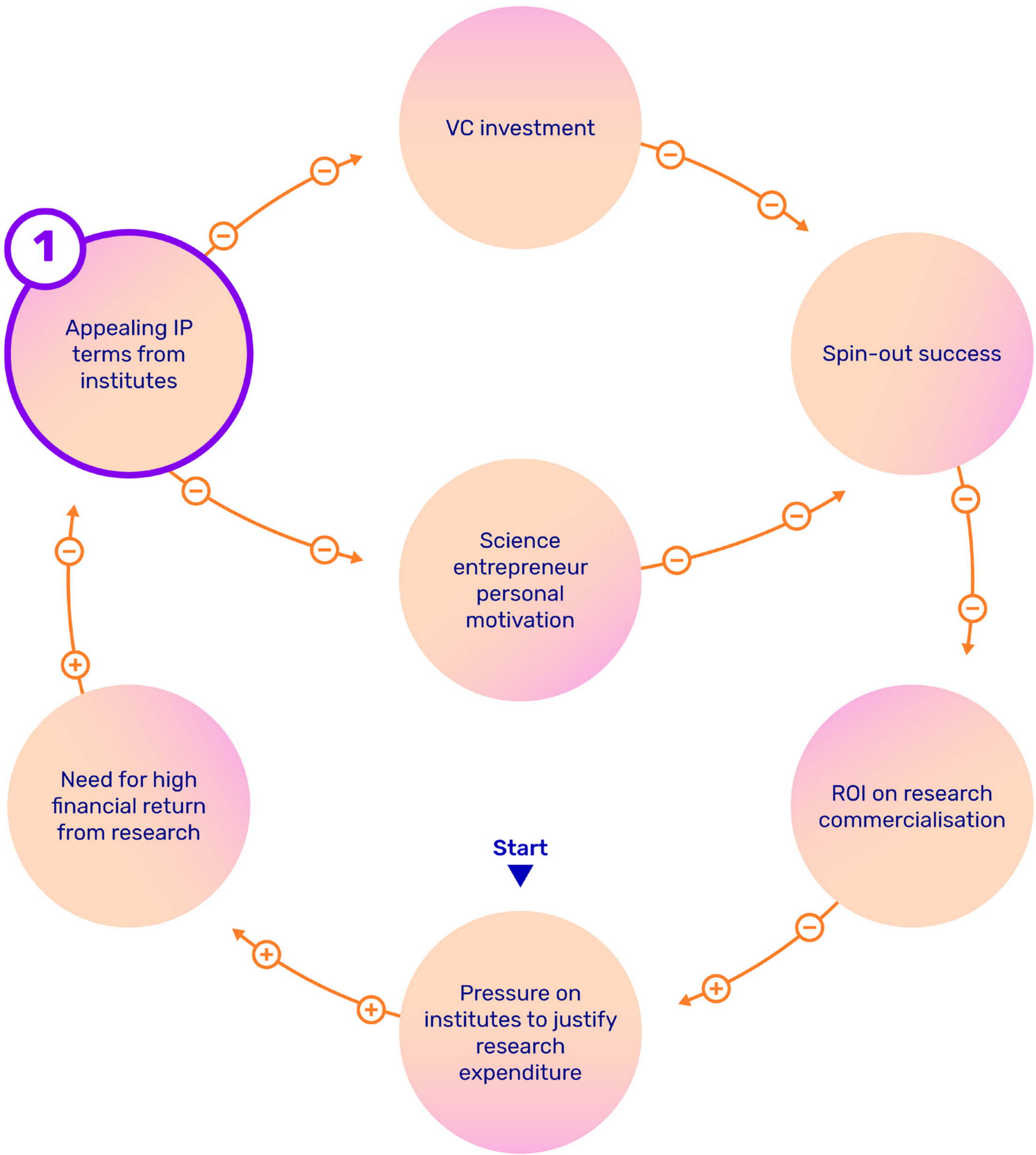
Diagram summary

The statements within circles either increase [+] or decrease [-] the likelihood of the factor(s) it is connected to.

Begin reading this loop from the blue arrow:

- **Science innovation specific accelerators** increases the availability of science innovation **specific entrepreneurial training** 1 and **availability of appropriate expert mentors** 2
- An increase in the **availability of science innovation specific entrepreneurial training** 1 increases access to appropriate, quality and timely guidance
- An increase in the **availability of appropriate expert mentorship** 2 increases the likelihood of access to appropriate, quality and timely guidance; shared experiences; access to networks; and knowledge of the funding landscape
- An increase in **access to appropriate, quality and timely guidance** increases the likelihood of a science entrepreneur making better business decisions
- An increase in **shared experiences** increase the likelihood of a science entrepreneur's resilience
- An increase in **access to networks** increases the likelihood of finding customers, partners, mentors and investors
- An increase in a scientist's **knowledge of the funding landscape** 3 increases the likelihood of finding appropriate funding
- An increase in **better business decisions; a science entrepreneur's resilience; finding customers, partners, mentors** and investors; and **finding appropriate funding** increases the likelihood of spin-out success
- An increase in **spin-out** success increases the likelihood of science entrepreneurs with lived experience and knowledge
- An increase in science entrepreneurs with lived experience and knowledge increases the likelihood of **availability of appropriate expert mentors** 2

Diagram 3: Intellectual Property Negotiations



Improving IP terms will allow science entrepreneurs to take on other investors more easily.

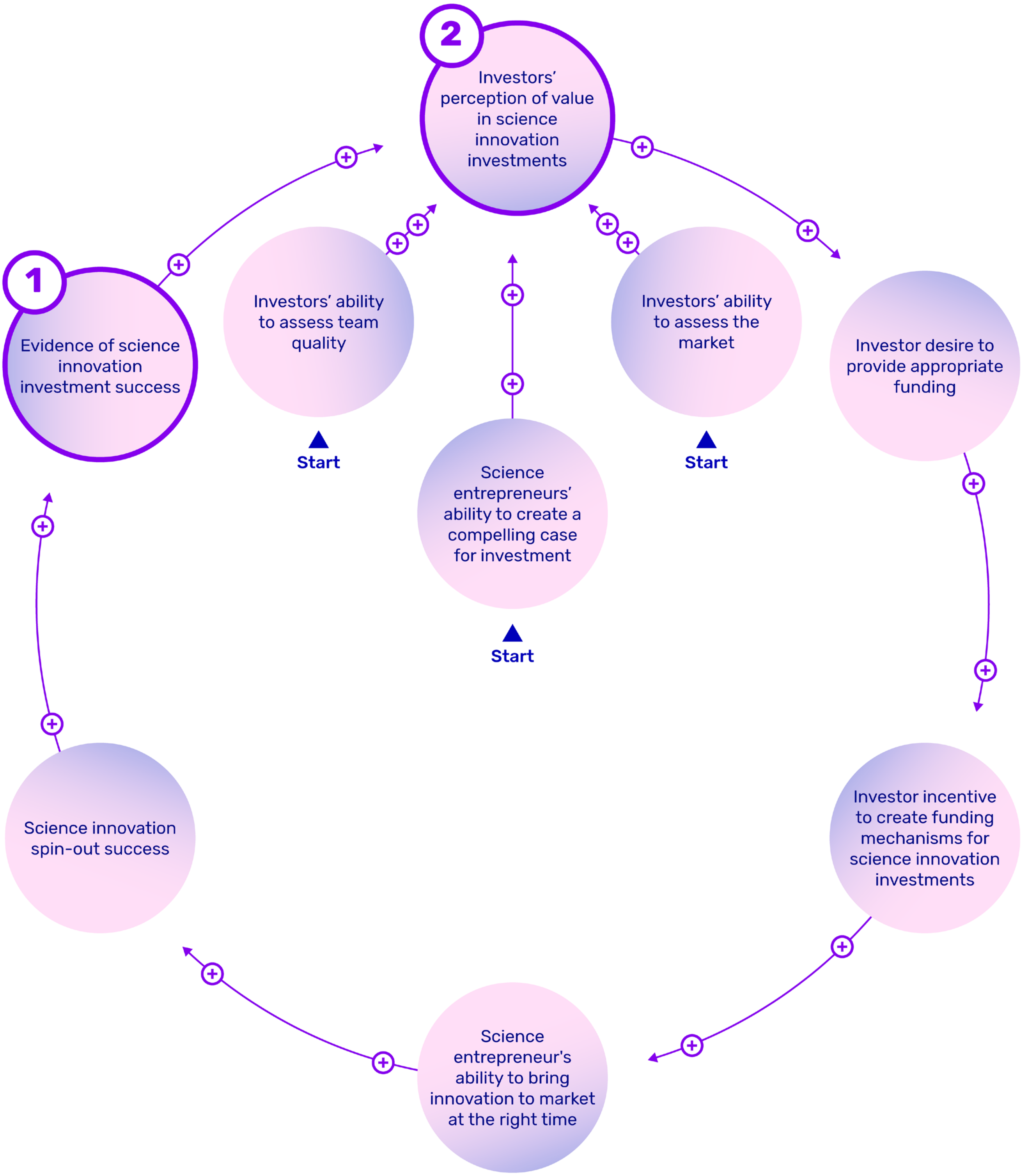
Diagram summary

The statements within circles either increase [+] or decrease [-] the likelihood of the factor(s) it is connected to.

Begin reading this loop from the blue arrow:

- The **pressure on institutes to justify research** expenditure increases the likelihood of needing a high financial return from research
- An increase in the **need for high financial return** from research decreases the likelihood of receiving **appealing IP terms from institutes** 1
- A decrease in **appealing IP terms from institutes** decreases the likelihood of a science entrepreneur's personal motivation, and decreases the likelihood of VC investment
- A decrease in the **likelihood of a science entrepreneur's personal motivation** and a decrease in the likelihood of **VC investment decrease** the likelihood of spin-out success
- A decrease in the likelihood of **spin-out success** decreases the ROI on research commercialisation
- A decrease in the **ROI on research commercialisation** increases the pressure on institutes to justify research expenditure

Diagram 4: Influencing Investor Attitudes towards Science Innovation start-ups



Improving investor attitudes towards science start-ups will increase the funding pool.

Diagram summary

The statements within circles either increase [+] or decrease [-] the likelihood of the factor(s) it is connected to.

Begin reading this loop from the blue arrow:

- An **investor's ability to assess team quality**, a **science entrepreneur's ability to create a compelling case for investment**, and an **investor's ability to assess the market** increase the likelihood of an investor's perception of value in science innovation investment
- An increase in the likelihood of an **investor's perception of value in science innovation** 2 investments increases the likelihood of investor desire to provide appropriate funding
- An increase in the likelihood of **investor desire to provide appropriate funding** increase the likelihood of investor incentive to create funding mechanisms for science innovation investments
- An increase in the likelihood of **investor incentive to create funding mechanisms for science innovation investments** increases the likelihood of science entrepreneur's ability to bring innovation to market at the right time
- An increase in the likelihood of **science entrepreneur's ability to bring innovation to market** at the right time increases the likelihood of science innovation spin-out success
- An increase in the likelihood of **science innovation spin-out success** increases the likelihood of evidence of science innovation investment success
- An increase in the likelihood of **evidence of science innovation investment success** 1 increases the likelihood of an investor's perception of value in science innovation investment

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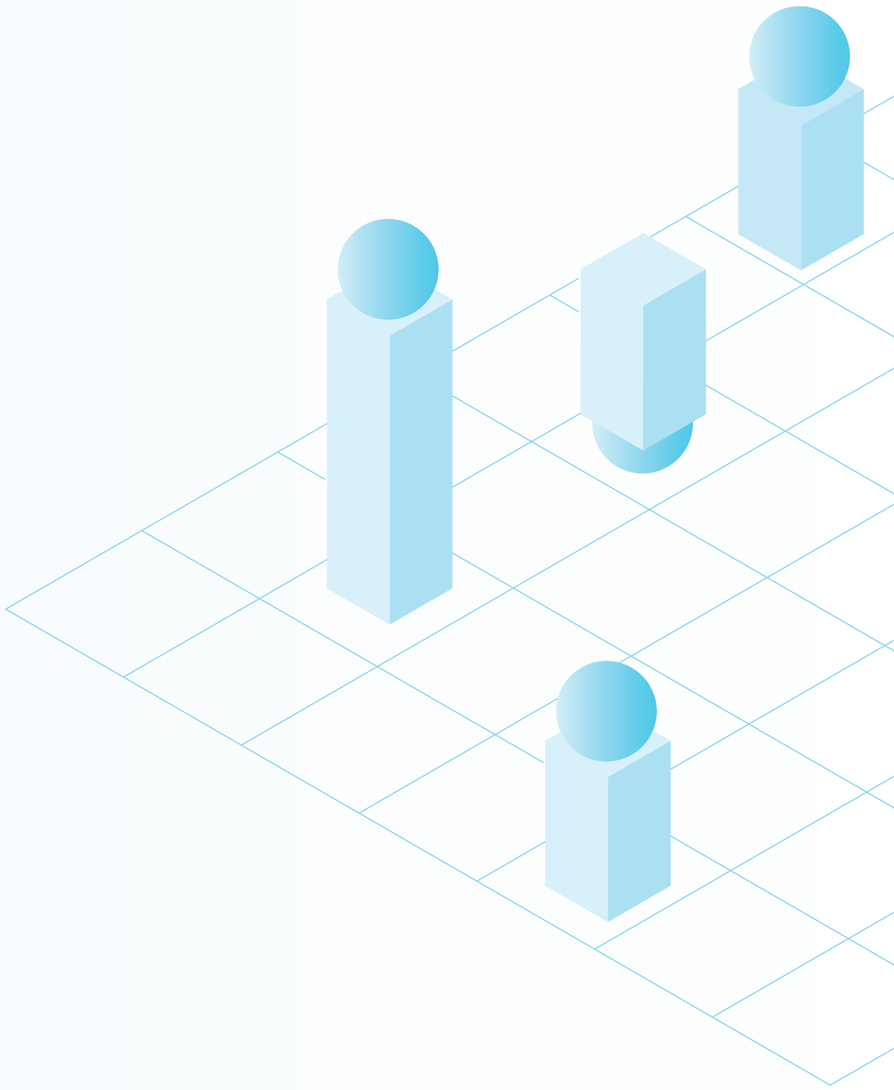

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