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HOW INNOVATION AGENCIES WORK:

International lessons
to inspire and inform
national strategies

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All errors and omissions remain the authors' own.

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FOREWORD

Politicians around the world can often be found announcing the launch of new innovation policies that are touted as being essential to the creation of a more prosperous and sustainable future. These are often accompanied by the establishment of ‘novel’ programmes that promise to do quite similar – and familiar – things: strengthening intellectual property rights, increasing the pool of risk financing, pushing universities to collaborate more with industry, or building new incubators, science-parks and accelerators.

Despite similarities in the methods that they use, some countries seem to be able to stimulate their economies toward a knowledge-economy growth path, while others do not. A great deal has been written about the causes of these national variations. However, very few studies have looked in detail at the organisations that are often leading these efforts – national innovation agencies.

This is why we embarked on the research that sits behind this report. Our aim is to help policymakers think more systematically and clearly about the choices they have as they go about building, restructuring and managing their innovation agencies. In doing so we have not identified any ‘silver bullet’ solutions or even a set of best practices which we urge policymakers in all countries to follow. Indeed our core finding is that there is no one-size-fits-all model for an agency of this kind, since the nature of what they are trying to do is inherently uncertain and complex and depends on differing national contexts and priorities.

At their heart, innovation policies aim to stimulate the creation and adoption of technologies and services that do not already exist. These policies must therefore create new actors (or imbue old ones) with the capabilities to create products and technologies that are not yet imaginable, to fill markets that do not exist, using business models that have yet to be developed. They must also stimulate these actors to use these new capabilities in a way that will positively affect economic growth.

Consequently, we are not talking about a process of long-term planning, but a process of continuous experimentation. Policymakers need systems and organisations that can rapidly develop new initiatives, drop those that do not work, scale up those that do, and then, as new industries emerge, work with them in a ‘co-evolutionary’ process to develop the support mechanisms that will help their future development, rather than respond to past needs. They also need policies and organisations that reflect their country’s particular level of development and current economic structure, and that are capable of identifying which practices will best suit their context.

To help inform this debate, the following report has three ambitions. First, it offers a broad typology of four different kinds of innovation agency, each of which represents a different national mission that can be better achieved using different methods and approaches to management and measurement. Using our case studies, we also examine the broad spectrum of programmes and instruments that are available to innovation agencies.

Building on this, our second aim is to start a vibrant debate around the development of an innovation agency ‘playbook’: a repository of innovation policy strategies and tools and an assessment of their effectiveness in accomplishing particular goals under different conditions. We think that this will be a much more effective tool for policymakers than an attempt to identify a single set of ‘perfect’ solutions.

Finally, having found very little good evaluation and evidence on innovation agencies as a whole, we aim to start a conversation about the development of proper qualitative, longitudinal, and quantitative metrics that will help to capture the full spectrum of what innovation agencies can and should be expected to achieve. In doing so, we do not underestimate the great difficulties involved in designing metrics that will help innovation agencies to understand their impact, without pushing them to work in ways that are detrimental to their long-term ambitions.

We view this report as a first step, and hope that you, the readers, will both find it useful and join us in devising and implementing a future policy research agenda on a subject which is essential to our continuous prosperity.

Dan Breznitz, Professor and Munk Chair of Innovation Studies, and Co-Director of the Innovation Policy Lab, University of Toronto

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SUMMARY

Governments around the world are looking for ways to nurture innovative businesses, as a way of solving some of their most urgent economic and societal challenges. This paper outlines the findings of an international comparative study of national innovation agencies, which we define as: **government-funded or managed institutions that provide financial and other support to catalyse or drive private sector innovation.**

Our aim was to investigate what best practice looks like in terms of designing and running an innovation agency and what mix of policies and programmes will be most effective in a given national context. To do this, we selected ten different innovation agencies to review that represented a cross section of geographies, approaches and levels of development:

- ★ Austria's **Research Promotion Agency** (FFG)
- ★ Brazil's **Funding Authority for Studies and Projects** (FINEP)
- ★ Chile's **Economic Development Agency** (CORFO)
- ★ Finland's **Funding Agency for Innovation** (Tekes)
- ★ Israel's **Office of the Chief Scientist** (OCS)
- ★ Sweden's **Governmental Agency for Innovation Systems** (VINNOVA)
- ★ Switzerland's **Commission for Technology and Innovation** (CTI)
- ★ Taiwan's **Industrial Technology Research Institute** (ITRI)
- ★ The United Kingdom's **Innovate UK**
- ★ The United States' **Defense Advanced Research Projects Agency** (DARPA)

For each organisation, we gathered data and stories about why they were set up and how they have changed over time, their organisational management structures, the methods and instruments that they have used to support innovation, and the impact their interventions have had.

Key insights from our research:

1. There is no single model for a 'successful' innovation agency

The diversity found even in our small group of case study innovation agencies suggests that determining the approach that will be best in a given country will only be possible after a detailed mapping of the national innovation system. There is much to learn from other countries about what works, in terms of designing and running an innovation agency and the programmes it implements. But attempts to directly replicate an organisation that operates in a very different political and economic context and that has a very different mission or a much larger budget are likely to fail.

2. Instead, there are a variety of roles that innovation agencies can perform

Although there is no one-size-fits-all approach, there are a number of models that can help to guide the choices made by policymakers about the type of innovation agency that will best suit their national context, resources and ambitions. From our case studies we have identified three roles that existing innovation agencies around the world play, with each having different implications in terms of the way the organisation is managed, the methods and tools that are used, and the metrics that might indicate success:



Market and System Fixers: seek to address failures in markets and networks that impede business innovation and investment in R&D, often without preference for specific technologies or sectors.



Industry Builders: focus on transforming an economy or creating new sources of economic competitiveness by investing in the development of a set of new sectors or technologies.



Mission Drivers: aim to induce innovations that address major societal and economic challenges, often in policy areas of significant traditional R&D spending such as defence, energy, the environment or health.

To this we propose the addition of a fourth, more experimental type of agency.



System Optimisers: work towards ensuring continuous global competitiveness and creating more effective and enabling innovation systems by experimenting with different policy and programme mixes.

3. Innovation agencies should not pursue too many roles simultaneously but should be capable of adapting to respond to new needs and opportunities

An innovation agency that is working towards many different objectives at the same time will find it difficult to establish a clear sense of purpose and a coherent portfolio of programmes. Mission creep may also lead the agency to spread its resources too thinly and fail to deliver on any of its objectives. However, having a long-term vision of what success looks like should not prevent an innovation agency from experimenting with new approaches and quickly responding to new needs and opportunities within the innovation system.

4. Assessment should involve both quantitative and qualitative judgements of an innovation agency's impact

Understanding and attributing impact to innovation agencies is particularly difficult, since they operate in uncertain and changing systems, make complex interventions, and aim to achieve outcomes that are inherently unpredictable. As such, measuring their impact needs to include quantitative assessments of their portfolios, but also involve judgements of the quality of their management, their ability to take (and learn from) strategic risks, and the skill with which they design and implement their programmes.

5. Governments should be both ambitious and realistic about what they want an innovation agency to achieve

As our case studies show, innovation agencies can have a significant impact – whether this is funding the development of technologies that will help solve a national challenge, seeding new industries, or filling funding gaps that would otherwise prevent the commercialisation of scientific research findings. Yet they are just one of a number of innovation policy levers that governments can pull, and will inevitably evolve and change along with government priorities. Understanding their role in the political process, and setting ambitious but realistic expectations for what these agencies can accomplish with the resources they possess, is one of the most important things that a government can do to help ensure that whatever innovation agency they design is able to fulfil its potential.

INTRODUCTION

Innovative businesses create more jobs and grow faster. Governments around the world are recognising that innovation is one of the most important drivers of sustained economic growth and prosperity, and a route to solving some of their most pressing societal challenges.

The role of government has been in part to create the conditions for innovation to flourish – from ensuring access to education, to encouraging an entrepreneurial culture or designing effective regulation. Beyond this, government innovation agencies can play a direct role as funder, purchaser, convenor, and navigator for new opportunities.

Examples of their impact span decades:

Take Elscint, which became the first Israeli business to be listed on NASDAQ in 1972, and developed a series of innovative medical imaging products before becoming a pioneer of the CT (computerised tomography) scanner in 1977. Elscint was transformed from a PhD dissertation into a multi-million dollar company with 2,000 employees, and became the model that Israeli high-tech companies followed for decades afterwards. Yet this success might never have happened without a series of conditionally repayable loans and grants provided by the government's Office of the Chief Scientist (OCS) throughout the 1970s, as part of a policy designed to increase research and development activities within Israeli businesses.¹

Consider the Taiwanese semiconductor industry, with annual sales exceeding \$70 billion.² Today it is vital to the country's electronics sector, which accounts for about 40 per cent of exports. Yet it might not have developed in this way if the Industrial Technology Research Institute (ITRI), a government-funded agency, had not incubated and spun-off companies such as the United Microelectronics Corporation (UMC) and Taiwan Semiconductors Manufacturing Company (TSMC). Those two companies became global leaders, employing tens of thousands of people with annual turnovers of multiple billions, and also pioneered a new way to organise IC chip production.³ In doing so, they transformed the global semiconductor industry into what it is today, succeeding where many other efforts have failed.⁴

Beyond particular companies or industries, the GPS technology that underpins geolocation software and many other industrial applications would not have emerged in 1995 without the sustained grants, contracts and collaborative programmes of the US Advanced Research Projects Agency, known today as DARPA. This autonomous agency of the US Department of Defense is now said to be working on a next generation alternative.

Stories of commercial success can take decades to emerge, and as innovation is not a linear or straightforward process, in some cases it is difficult to disentangle the role of the innovation agency in the narrative. In other cases it can be more straightforward. For example, the founders of Swiftkey, which incorporates predictive language capabilities into the keyboards of mobile phones, acknowledge the role of early injections of finance (£15,000 of seed funding followed by a further £50,000 grant for prototyping) from Innovate UK, the UK's national innovation agency, in the company's success. In six years Swiftkey went from London-based startup to global player, with the app downloaded and installed on more than 300 million devices.⁵ It was finally bought by Microsoft in 2016 in a deal thought to be worth around US\$250 million. According to Swiftkey founder Jon Reynolds, *"The prototype we built with grant funding from Innovate UK helped us prove the technology worked. It was a critical step towards accessing venture capital investment and getting the app to market."*⁶

For every story of success we can expect many more examples of failure. Innovation agencies operate in a context of ‘radical uncertainty’,⁷ attempting to support the development of breakthrough technologies, entirely new industries and markets. This has led experts to argue that the best approaches to innovation policy should be adaptive and experimental.⁸ Yet organisations are needed to develop, store and share this craft knowledge. Alongside design, implementation is critical.

Policymakers around the world aiming to emulate these successes still struggle to understand what best practice looks like in terms of designing and running an innovation agency and what mix of policies and programmes will be most effective in a given national context. The search for applicable, practical lessons has been hindered by three main things:

- ★ A failure to recognise the diversity of organisational models, and a tendency to replicate institutions or programmes that are not the most appropriate match for ambitions, resources and context.
- ★ The difficulties involved in measuring and understanding what works when it comes to innovation policy, and being able to attribute success to specific interventions.
- ★ A poor understanding of the ways in which successful agencies adapt, experiment and evolve over time, and how to build this flexibility into their structure from the start.

Over the past year, Nesta has set out to address this gap in knowledge by looking in detail at the approaches of ten innovation agencies around the world. Our aim has been to improve understanding of the range of institutional models and to learn more about their design, evolution and effectiveness. The agencies chosen represent a cross section of geographies, approaches and levels of development. This report divides our analysis into three parts:

In **Part 1**, we explore how innovation agencies work, drawing on the latest literature and evaluations, a series of in-depth interviews (a full list of interviewees and contributors can be found at the end of this report) and ten detailed case studies. We explore the core characteristics shared by diverse innovation agency models, the programmes and tools they use as well as the challenges that they face in achieving and demonstrating impact.

In **Part 2**, we synthesise the various approaches to outline four different roles that an innovation agency might play, to help demonstrate the range of choices and implications at stake.

In **Part 3**, we look at how these insights can be applied to inform practical decision-making by governments. In particular, we set out key strategic design questions and choices involved for those who want to set up a new organisation or optimise the effectiveness of an existing innovation agency.

We end with a set of Conclusions drawn from our research, and full Case Studies of the ten organisations we have looked at in depth, providing the most comprehensive qualitative comparative review of innovation agency approaches that we know of to date.

Part 1

UNDERSTANDING INNOVATION AGENCIES

No two innovation agencies are exactly alike. The case studies in this report are striking in their diversity. They are structured differently and use a variety of programmes and instruments to achieve their goals. Some focus on delivering the priorities of their sponsoring governments, while others are more autonomous and experimental in their approach. They also operate in very different economic and political contexts. However, they share a number of core characteristics – in the ways they operate and the challenges they face – that allow us to draw generally applicable insights for those involved in setting up and running an innovation agency.

In this chapter we first clarify what an innovation agency is, and the unique role it plays within the landscape of public support for innovation. We then introduce our ten case study organisations – drawn from both advanced and rapidly emerging economies around the world. Using these examples we highlight the range of policy and programme tools used by innovation agencies. Finally we turn to the crucial issue of understanding the value added by innovation agencies, and why this is so challenging to measure.

1.1 Innovation agencies in the landscape of innovation support

Innovation policy refers to a large and growing range of public interventions (see Table 1) that seek to support the generation and diffusion of innovation – the ability to generate and adopt new knowledge and ideas. It involves increasing the supply of resources for innovation through grants, subsidies and skills, as well as creating demand to pull innovation through the system and influence markets through regulation, standards and using the huge purchasing power of governments.

Table 1: A goal-based categorisation of innovation policy interventions⁹

| Goal | Examples |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Increasing inputs to innovation | R&D tax credits, grants for R&D, public support for venture capital |
| Increasing non-financial capabilities (e.g. access to skills and expertise) | Support for exploiting IP, technical support services, skilled migration and mobility schemes |
| Enhancing connections and complementarities | Cluster policy, support for networks, collaborative R&D programmes, support for intermediaries |
| Enhancing demand for innovation | Public procurement policies, pre-commercial procurement of R&D, standards, regulation |
| Improving framework conditions for innovation | Support for the business environment |
| Improving discourse and preparedness | Foresight and horizon scanning, technology roadmapping exercises |

There is a complex landscape of institutions that support innovation, including:

- ★ **Research and Technology Organisations (RTOs):** generally defined as public or private non-profit organisations that build links between different players in the innovation system and provide a range of research, development and technology services, primarily to business and governments.¹⁰ An example of an RTO is the VTT Technical Research Centre of Finland, which has a national mandate, but works with a range of clients both in Finland and abroad, to develop science and technology solutions and networks.
- ★ **Incubators and Accelerators:** publically-funded organisations that give different mixes of support to very early-stage companies, from subsidised dedicated spaces, to mentorship, pooled administrative support, or modest seed financing. An example of this is the technology incubators programme of the Office of the Chief Scientist, which has established and funded private-public incubators across Israel since 1993.
- ★ **Technology Transfer Offices (TTOs):** sometimes described as knowledge transfer centres, these are institutions designed to bridge the gap between research and innovation by supporting the practical transfer of knowledge within the economy.¹¹ While they are generally attached to a public research organisation, such as a university, they often have quite autonomous organisational structures. An example is Imperial Innovations plc, a unit attached to Imperial College London in the UK, which creates and invests in technology companies and licensing opportunities developed from scientific research discoveries.
- ★ **Research funding councils:** bodies that provide public funding for scientific research and training. These organisations often work with businesses and may support projects with potential commercial benefits, but their primary purpose is to fund discovery-oriented research that will advance knowledge and generate new ideas.¹² An example of this is the network of UK Research Councils, seven organisations which collectively invest more than £3 billion a year in UK research across the full spectrum of academic disciplines.
- ★ **Research and innovation advisory bodies:** groups of experts which have responsibilities ranging from providing advice to governments and others on their innovation strategies through to directly coordinating strategy and allocating budget in key areas of innovation policy. An example of this is the National Council for Innovation and Quality in the Public Sector in Sweden, which was established in 2014 to drive innovation and change in public services.
- ★ **Innovation investment funds or business banks:** institutions that finance R&D conducted by businesses or business-research partnerships alongside other business activities. An example of this is Bpifrance, a public investment bank that uses a mix of financial instruments (including loans, equity investments and guarantees) to help French companies grow and internationalise.
- ★ **Public sector innovation teams or 'i-Teams':** units, teams or funds set up to transform the way that governments innovate.¹³ These can operate at national, regional or local levels, and tackle a broad range of economic and societal challenges. An example of an innovation team is the Mayor's Office of New Urban Mechanics in Boston, which is designed to develop and pilot new ways of engaging citizens, civil servants, academia and others in solving civic innovation problems.

Although there are examples of innovation agencies that perform some of these roles, the institutions we have looked at in this project do not fit neatly into any of these categories. We therefore propose the following definition of national innovation agencies as: **government-funded or managed institutions that provide financial and other support to catalyse or drive private sector innovation.**

1.2 Our case studies

To understand what this means in practical terms, we selected ten different innovation agencies to review, gathering data and insights on their missions, their organisational management structures, and the methods and instruments that they have used to support innovation.

Map 1 shows the location of these agencies, alongside a selection of comparable organisations from other countries.

Map 1: Innovation agencies



We chose these organisations both for their similarities and their differences (Table 2 below provides a snapshot comparison).^{*} All are institutions that show promise or have been successful in the past. Most provide some kind of direct financial support to companies, and do so primarily - although not exclusively - to stimulate economic growth, rather than social innovation. They have also been running for long enough to make some informed judgements about their performance to date, and to track how their strategy and operations have evolved over time.

Table 2: Snapshot comparison of case study agencies

| Agency | Established | Started directly supporting companies | Current staff numbers | Total annual budget (US\$) | Proportion of budget spent on direct support for companies |
|-----------------------------|-------------|---------------------------------------|-----------------------|-------------------------------------|------------------------------------------------------------|
| FFG, Austria | 2004 | 2000s | 275 | 660 million (2015) ¹⁴ | 56% ¹⁵ |
| FINEP, Brazil | 1967 | 2000s | 740 | 2.1 billion (2014) ¹⁶ | 37% ^{17, i} |
| CORFO, Chile | 1939 | 1980s | 685 | 345 million ¹⁸ | 26% ¹⁹ |
| Tekes, Finland | 1983 | 1980s | 400 | 660 million (2014) ²⁰ | 64% ²¹ |
| OCS, Israel | 1974 | 1970s | 100 | 450 million (2015) ²² | 95% |
| VINNOVA, Sweden | 2001 | 2000s | 205 | 355 million (2015) ²³ | 30% ²⁴ |
| CTI, Switzerland | 1943 | 2000s | 35 | 165 million (2014) ²⁵ | 17% ^{26, ii} |
| ITRI, Taiwan | 1973 | N/A ⁱⁱⁱ | 5,650 | 625 million (2014) ²⁷ | N/A |
| Innovate UK, United Kingdom | 2007 | 2000s | 300 | 870 million (2014/15) ²⁸ | 84% ^{29, iv} |
| DARPA, United States | 1958 | 1960s | 220 | 2.9 billion (2016) ³⁰ | N/A ^v |

Notes:

All spending figures in the table have been converted to US\$ (using current exchange rates) and rounded to the closest 5

i) Figures for the same calendar year are not available, so the proportion of the budget spent on companies should be treated as an estimate

ii) The CTI does not fund businesses directly, but does provide funding for research-led projects that involve businesses. The figure for direct spending on innovation support for companies includes the small budget set aside for entrepreneurship and coaching support for Swiss companies.

iii) ITRI does not directly fund businesses, but runs R&D projects in-house that can lead to the development and spin out of new ventures.

iv) This does not include the amount spent on not-for-profit private companies, which are not disaggregated in Innovate UK's accounts.

v) DARPA spends a significant proportion of its budget on private sector R&D contracts, although it is difficult to find a single figure from publically-available information. One relevant programme to flag in the context of this table is the Small Business Innovation Research (SBIR) programme, which was set up by DARPA in 1982. This marked the start of the agency's direct provision of R&D commercialisation grants to small businesses. In 2014 (the year for which the most recent data is available), the budget for this programme was \$80 million.³¹

^{*}We recognise that there are many other organisations that could be categorised as innovation agencies that are not described in this report. Their omission does not indicate any judgement on our part regarding their effectiveness, but instead reflects our aim to produce a short and accessible report that can open a dialogue with policymakers worldwide.

1.3 What we have learned about how innovation agencies support businesses

Our research looked in detail at the methods and tools used by our case study agencies to support innovative activities within businesses. Across these ten organisations we observed four main types of assistance:

- ★ Direct financial support for businesses (such as grants or loans).
- ★ Non-financial assistance for businesses (such as advisory or matchmaking services).
- ★ Support for intermediaries (such as support for business incubators or accelerators).
- ★ Connecting and institution-building activities (such as knowledge transfer programmes).

A fifth way in which innovation agencies can stimulate innovation is by running in-house research and development projects. This has been the approach of ITRI in Taiwan, which is made up of several units and centres that test, pilot and prototype new technologies to help reduce the risks associated with market transfer. DARPA in the US has a similar function, in that their programme managers play a very active role in designing and managing portfolios of grants for technological R&D projects. However, most of the agencies we looked at act more as funders than direct creators of innovation, as Table 3 shows.

Table 3: Comparison of main support methods used by our case study agencies

| Agency | Direct financial support | | | Non-financial assistance | Support for intermediaries | Connecting and institution-building | In-house research and development projects |
|-----------------------------|--------------------------|-------|-------|--------------------------|----------------------------|-------------------------------------|--------------------------------------------|
| | Grants | Loans | Other | | | | |
| FFG, Austria | x | x | x | x | x | x | |
| FINEP, Brazil | x | x | x | | x | x | |
| CORFO, Chile | x | x | x | | x | x | |
| TeKes, Finland | x | x | x | x | x | x | |
| OCS, Israel | x | x | | x | x | x | |
| VINNOVA, Sweden | x | | | x | x | x | |
| CTI, Switzerland | x | | | x | x | x | |
| ITRI, Taiwan | | | | x | x | x | x |
| Innovate UK, United Kingdom | x | | | x | | x | |
| DARPA, United States | x | | x | x | | x | x |

Notes:

Data gathered from our background research and interviews with individual innovation agencies

In Table 4 below we outline some of the main instruments used by innovation agencies, illustrated by examples from our research. Further information can be found in the detailed case studies.

Table 4: Support instruments commonly administered by innovation agencies

| Instrument | Description | Example |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direct financial support for businesses | | |
| R&D grants | Non-repayable transfers of money. These are often linked to a specific project and may be stage-gated in connection with the recipients meeting certain terms and conditions. | VINNOVA invests 10 per cent of its budget in grants for technology projects that develop cross-sectoral responses to major societal challenges in Sweden. |
| Convertible grants | Grants that may convert into full or partial loans, contingent on the achievement of defined milestones. | The OCS offers partial grant funding of up to 50 or 60 per cent of project costs (depending on the size of the organisation and the specific programme). If sales occur as result of the project, royalties are used to repay the grant to the OCS. |
| Loans | Money lent to be repaid (usually with interest, although often set at very low levels) over the course of a project. | Tekes offers low-interest loans to help businesses test out new products, services, production methods and business models. For product development and piloting projects that are close to commercialisation, Tekes will typically make loans covering 50 or 70 per cent of the project's total costs. |
| Equity investments | Loans or investments offering revenue participation rights, or ownership rights of the company. | FINEP makes direct investments in strategic innovative projects in Brazil. It also invests in innovation through funds, corporate venture and venture forums. Just over \$1billion Brazilian reais (the equivalent of around US\$290 million) was put towards this in 2014. |
| Government-backed venture capital funds | Government financing of VC investors or funds. | In 2013, the Finnish government set up Tekes Venture Capital Ltd, a state-owned company steered by Tekes that invests in venture capital funds administered by private management companies. The focus of its investments is high-risk R&D projects conducted by early-stage Finnish companies. |
| R&D tax credits | Tax incentives designed to increase the levels of resource that businesses commit to R&D (often targeted at young innovative companies). | The FFG runs a programme to select Austrian companies eligible to receive a 12 per cent tax premium for R&D activities. |
| Challenge or inducement prizes | Commitments of funding linked to evidence of ability to solve a novel problem. | DARPA administers a series of prizes to encourage the development of new solutions to 'grand challenges' (for example, a prize was run in 2004 to fund the development of 'driverless' cars). Prize money is only paid out if a successful solution is found. |

| | | |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Research and development (R&D) contracts | Government acts as lead customer, undertaking pre-commercial procurement of R&D from firms (often small businesses) to provide an alternative route to market for innovations and stage-gated access to major public R&D contracts. | Innovate UK manages the Small Business Research Initiative (SBRI), which connects public sector challenges to innovative ideas from industry, advertising R&D contracts to solve specific challenges through an open platform. |
| Non-financial assistance for businesses | | |
| Knowledge services | Support to help businesses develop the knowledge and skills that will help them innovate more effectively. | The CTI in Switzerland devotes 10 per cent of its budget (but nearly 100 per cent of the staff time of its small secretariat) to programmes that deliver mentoring and coaching to high growth potential businesses. |
| Business development support services | Provision of resources that help overcome practical barriers to engaging in innovation, such as access to physical space. | Since 2005, ITRI's 'Open Labs' have provided facilities, utilities, business services and research support to startups to help reduce the barriers to development, testing and piloting of new ideas or products. |
| Matchmaking services | Assistance for businesses in finding additional sources of funding for R&D activities, domestically or internationally. | The FFG is Austria's contact point for a range of European funding programmes (such as the Horizon 2020 scheme), and offers assistance to businesses in finding partners and preparing applications. |
| Innovation management education | Support for the development of R&D and innovation management knowledge and skills. | Tekes has run many workshops educating executives of established, non-innovating companies about both the benefits and the practical management of innovation and R&D. These activities are widely acknowledged as having been crucial in stimulating innovation within Finland's private sector. |
| Support for intermediaries | | |
| Intermediary funding | Funding of third party institutions which invest in or support business innovation (such as incubators or accelerators). | CORFO subsidises innovation and business incubators operating across Chile. For example, between 2003 and 2008 it invested around US\$11 million to fund the creation of 27 business incubators. |
| Connecting and institution-building activities | | |
| Knowledge and technology transfer activities | Programmes designed to promote transfer of knowledge and technologies between research and industry. | Innovate UK now manages a long-running and widely-respected Knowledge Transfer Partnership scheme that places recently qualified graduates in businesses to conduct strategic innovation projects. |
| Competence centres | Domain-focused physical centres designed to facilitate collaborative R&D projects between research institutions, businesses, public sector bodies and others. | Tekes was involved in establishing a number of Strategic Centres for Science, Technology and Innovation that bring together research organisations and companies to conduct R&D projects in key thematic areas. |

| | | |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Research consortia | Support for research consortia that involve several companies and/or research organisations. | Both ITRI and the OCS have sponsored research consortia across a wide array of technological and industrial areas. |
| Internationalisation of innovation collaboration | Support for the development of international collaborative R&D projects or exchanges. | The BIRD foundation (Bi-National R&D USA-Israel) offers financial support and conducts matchmaking between Israeli and US firms around projects to jointly develop and sell novel products. |

Notes:

This table draws on observations from our case study agencies, as well as a review of the wider literature around support for business innovation. Two particularly relevant papers can be accessed at: https://innovationpolicyplatform.org/sites/default/files/rdf_imported_documents/Financing%20business%20innovation%20TOT.pdf and <http://www.nesta.org.uk/blog/landscape-funding-tools>.

1.4 What we have learned about how innovation agencies work - and the challenges they face

Our research also looked at the way that innovation agencies are **designed and managed**. From our case studies, we highlight four key observations about the opportunities and challenges associated with the way that they operate:

Innovation agencies often operate with considerable autonomy

While governance arrangements vary, innovation agencies tend to have a considerable degree of strategic and operational independence from their sponsoring governments. This has been particularly true of pioneering bodies such as the OCS and DARPA. Israel’s agency was a marginal player when it started out – both in terms of resources and political cache - operating on the periphery of the public sector. However, this relative obscurity gave it the space to experiment with new support models and instruments without much interference, which allowed it to build ‘high walls’ between the agency and central government.³² While DARPA is much bigger and pursues a more specific national mission, it has been similarly free to test out radically innovative ideas. The agency’s programme managers create portfolios of projects, critique each other’s ideas and progress, and actively manage the contractors on each project, with little direct management from the Department of Defense.

Autonomy manifests itself differently in agencies with a greater business support role. For example, VINNOVA uses its strong connections with industry to influence government innovation policy. Each industry brings together relevant players (including large and small companies, academic research institutes, the public sector and civil society) to develop a roadmap and a set of key concerns. VINNOVA then decides which of these competing innovation agendas to develop programmes around, and feeds this into the design of the Swedish government’s four year innovation strategy. While government earmarks a certain amount of money for issues that it thinks the agency should work on (around a fifth of VINNOVA’s budget currently), these are “*brushstrokes rather than detailed instructions*”.³³

The autonomous nature of innovation agencies is frequently reinforced by the skills and expertise that they possess – whether this is held in-house or sourced from outside. Innovate UK’s recruitment strategy has been designed to bring in people who have worked in industry or have particular technological expertise, rather than policy generalists seconded from the civil service. Most of ITRI’s 5,500-plus employees have an engineering background, and manage programmes

designed to directly result in innovative products or processes. Meanwhile, the CTI in Switzerland and the OCS in Israel have both taken a ‘commissioning’ approach, drawing on the knowledge and skills of a panel of experts from industry, academia and civil society to make decisions about which project applications will receive funding.

Innovation agencies cannot be entirely separate from political processes

While many of the agencies we have looked at are committed to investing in long-term or high-risk business innovations, they often find this difficult to balance with the needs and timelines of politicians and policymakers, especially if they have a high profile and a large budget. This problem has become more acute since innovation has emerged as a salient political issue, with senior political leaders frequently mentioning it as part of their national vision. For example, FINEP in Brazil has developed a number of innovation-support initiatives that have been scaled up into government-wide programmes, such as INOVAR, a widely respected scheme that has increased the levels of venture capital available to technology-based Brazilian startups. However, the agency continues to have its budget set by the Secretariat of State for Science, Technology and Higher Education on a year-by-year basis, limiting its ability to make longer-term investments.

For CORFO in Chile, changing political priorities have had a direct impact on the agency’s internal structure, which has had to set up, abolish and then recreate a ‘productive cluster’ committee over the past eight years in response to the policy reversals of three consecutive governments. And in the United Kingdom, Innovate UK is currently facing a major change in its funding model (with around a third of its current spending due to be converted from non-repayable grants into repayable forms of finance by 2020) as a result of a government-driven effort to capture a larger share of the return from successful projects that it funds.³⁴

These observations highlight some trade-offs that policymakers should be aware of. In particular, the ability of an innovation agency to experiment and take risks may diminish if it does well and attracts high levels of political attention. This has led some scholars to suggest that ‘successful’ innovation agencies may need to embrace ‘the politics of partial success’ and set more modest goals for themselves, both in terms of what they do (for example, focusing on effective upgrading of the economy rather than complete structural transformation) and the rate at which they do it.³⁵

Alternatively, policymakers that set high ambitions for their innovation agencies need to be realistic about what they expect them to achieve, and recognise that more complex and high-risk interventions may take longer to come to fruition than political cycles demand, or indeed, might fail entirely.

Measuring and evidencing the long-term or systemic impact of their portfolio is challenging for innovation agencies

All of the innovation agencies studied in this research have experienced difficulties in evaluating and articulating the value created by their interventions. Some agencies have used a range of econometric tools to estimate the quantitative impact of their support for business innovation. For example, the FFG in Austria reckons that every euro it has invested in research between 2004 and 2013 has resulted in an additional 12 euros worth of long-term additional turnover for companies. Innovate UK’s evaluation of its largest funding programmes have led it to claim that its activities have supported projects estimated to have created 55,000 extra new jobs. And in Finland, a longitudinal economic database of business R&D has indicated that more than 60 per cent of well-known Finnish innovations have received funding from Tekes.³⁶

However, the more systemic changes thought to have been brought about by some innovation agencies (such as the OCS's success in fostering a culture of business innovation in Israel) are very difficult to evaluate quantitatively over a short time period. This has created challenges for agencies that often need to demonstrate some kind of return on public investment, but that are also involved in supporting high-risk projects that are not guaranteed to succeed, or where much longer time frames are needed to achieve impact.

It is hard to identify a single model of a 'successful' innovation agency

To remain on the cutting edge of innovation support, innovation agencies have to be responsive to the changing needs of government and industry, and capable of shifting their approach and their methods accordingly. Looking across our case studies we find that very few existing innovation agencies have retained their original structure and focus, especially if they have been running for many years.

For example, Tekes in Finland started out with a programme of investments designed to stimulate specific industries, but now devotes nearly half of its budget to 'responsive' investments – funding companies with good ideas across a wide range of domains. Brazil's FINEP underwent a major shift in 2004 when it started offering direct financing to firms, after three decades spent delivering government funding programmes for research and academic institutions. And in less than a decade, Innovate UK evolved from a small government advisory panel that took on responsibility for a set of pre-existing R&D support programmes to an organisation of more than 300 people that spends some £600 million annually on a range of technology funding competitions.

This inherent adaptability makes it difficult to identify a single ideal model for an innovation agency. This has not stopped governments from trying to copy other models, with DARPA being a particular inspiration. But DARPA's approach and legacy is the product of a set of unique political and military conditions in the United States that would be hard to reproduce almost anywhere else in the world (see Box 1).

Box 1: The ‘DARPA effect’

DARPA looms large in the political imagination of politicians and innovation policymakers worldwide. In 2013, Japan announced the establishment of a new agency that would research, develop and adapt cutting edge technologies for possible military use.³⁷ In late 2015, the British government confirmed that it would be investing £165 million a year in a new Defence and Cyber Innovation Fund designed to support innovative procurement – a DARPA for cyber security.³⁸ And China is also reportedly planning to create a DARPA-style agency to invest billions of dollars in defence modernisation and R&D projects.³⁹

Yet DARPA is particularly anomalous among innovation agencies, for three key reasons:

- ★ **It was set up to make highly risky investments in breakthrough technologies** that would enhance national security and give the US a decisive strategic advantage. While its investments have resulted in innovations with major commercial and social significance (such as the Internet and GPS technologies), most of these have been useful ‘spillovers’, rather than the result of projects designed to create new commercial products or services.
- ★ **Its budget is immense.** The agency spends nearly \$3 billion a year on the projects it supports – more than four times the budget of Innovate UK or similar organisations in other rich countries. It has access to an even larger US defence procurement budget, which at \$600 billion is nearly equal to the annual spend of the entire UK public sector. And it sits alongside a constellation of other funding bodies, such as the Office of Naval Research. With this scale of resource, DARPA can make large and risky bets in the knowledge that while most of them are unlikely to succeed – and we know very little about DARPA’s failure rate – the few that do will pay off spectacularly.
- ★ **It has enjoyed strong and consistent backing at the highest political levels,** and been given a huge amount of freedom to test out radical ideas.

DARPA’s emergence and historical legacy is the product of very specific circumstances that would be extremely hard to replicate now in almost any other country. As such, while aspects of its approach are very deserving of further study, there is a clear need to shift the perception among many policymakers that being ‘more like DARPA’ is the only route to success.

Our case studies suggest that the most effective innovation agencies adapt in line with the needs and opportunities of the system they operate within. This makes it challenging to develop an ‘off the shelf’ model that will suit countries at quite different stages of economic and political development. Nevertheless, it is possible to identify a number of core ‘missions’ that innovation agencies tend to pursue, which have a variety of implications for the way they are designed, the methods they use, and their metrics for what ‘success’ might look like. We turn to this in the next section.

Part 2

DIFFERENT ROLES FOR AN INNOVATION AGENCY

Every innovation agency is a product of a unique political, economic and historical context, is likely to regularly evolve its institutional structure, and to combine a range of different approaches to supporting innovation. However, we believe it is possible, and useful, to draw out a set of general innovation agency 'roles' from these examples which expose the contrasting set of agendas, capabilities and possible outcomes in play.

From our research, we have identified three relatively clear existing 'types' of innovation agency, which we describe as:

- ★ **Market and System Fixers**
- ★ **Industry Builders**
- ★ **Mission Drivers**

This list is not comprehensive, and in practice there is a fair amount of overlap in the methods used by different types of innovation agency (particularly in terms of direct grants for R&D). Agencies may also shift between roles over time. However, we believe it is a helpful way to start distinguishing between different approaches, and thinking about the kinds of management structures, methods and metrics of success that might be associated with each.



Market and System Fixers

Mission:

Market and System Fixers deliver programmes that address market and system failures and seek to increase levels of business investment in innovation. They provide funding and other support to lower the risk of R&D projects, often without any preference to specific technologies or sectors.

Management:

- ★ Core expertise in delivering competitive programmes for innovation support.
- ★ Highly networked, they are likely to work with several government departments and other parts of the innovation system by nature of their 'horizontal' programmes.
- ★ Likely to utilise large external expert networks to evaluate projects in a varied array of technology and market sectors.
- ★ Aim to be responsive to and integrated with the needs and interests of the business community as well as to drive new behaviours around innovation investments. This might be achieved by recruiting staff from industry (an approach that has explicitly been taken by Innovate UK), by using an extensive network of industry consultants to

evaluate project proposals (an approach used widely by the OCS), or by undertaking comprehensive business consultation activities (as Tekes does).

- ★ Likely to be semi-autonomous, as delivery agencies closely linked to a host department of government.

Methods:

Market and System Fixers are likely to operate a range of programmes - often as competitive, open funding, including:

- ★ Direct subsidies and grants for R&D in businesses and universities (with an emphasis on non-repayable or conditionally repayable grants).
- ★ Non-financial support for businesses, such as coaching and mentoring.
- ★ Support for intermediary bodies and the wider innovation support ecosystem.
- ★ Connecting and institution-building activities to bridge systemic gaps.

Metrics of success:

Market and System Fixers are likely to measure the results of their interventions using both quantitative and qualitative metrics, including: the numbers of businesses supported; relevant productivity and employment data (such as numbers of jobs created); intellectual property developed as a result of supported projects; co-investments leveraged by grantees; repayment rates (on conditional forms of financing); increased levels of business investment in R&D; the number of sustainable collaborations that result from funding; and perception data (such as whether attitudes and behaviours around innovation have changed as a result of support).⁴⁰



Industry Builders

Mission:

Industry Builders focus on transforming an economy by developing a specific set of new sectors or technologies, for example in green-tech, biotech, or nanotech industries.

Management:

- ★ Likely to be closely linked to government and the delivery of industrial strategy goals and regional and cluster policies.
- ★ Staff require deep technical expertise in the relevant industry or sector and the ability to conduct R&D in-house or in collaboration with other public agencies, thus employing a higher proportion of engineers and scientists than other innovation agencies.

Methods:

Industry Builders will focus on activities that encourage the creation of clusters of innovative businesses in specified industries. Their methods may include:

- ★ Direct investments or funding for companies in selected sectors or industries.
- ★ In-house development and spin-out of new ventures.
- ★ Investment in the wider support 'ecosystem' for innovative businesses (such as investments in incubators or accelerators).
- ★ Activities designed to commercialise and internationalise business innovations.

Metrics of success:

The primary indication of success for an Industry Builder would be the emergence of a new industry that creates a national competitive advantage. Interim indications of success for this might include the creation of a set of new businesses, the development of new patents, and higher levels of global or regional market share for targeted industries. ITRI's development of the technologies that helped Taiwan's semiconductor industry grow to produce 40 per cent of the country's exports is a good example of this.



Mission Drivers

Mission:

Mission Drivers induce innovations that address major societal and economic challenges. They often operate in policy areas of significant traditional R&D spending such as defence, energy, the environment or health, and aim for a step-change in outcomes, rather than incremental improvements.

Management:

- ★ Likely to involve a combination of in-house development or applied research activity with significant external funding as part of technological or societal missions.
- ★ Expertise in problem selection and articulation, possibly gained through time-bound expert contracts for the duration of projects rather than permanent positions.
- ★ Likely to network basic, applied research and commercial R&D activities in a specific challenge area.
- ★ Likely to operate with significant operational autonomy.

Methods:

Rather than commercialisation programmes or support for existing commercial R&D projects, methods are likely to focus on stimulating new markets for technologies and providing a pathway to future commercial opportunities that respond to a specific national challenge. Methods could include:

- ★ Acting as a lead customer - using procurement budgets and public contracts to 'pull' innovative solutions to challenges from the market.
- ★ Direct funding of business innovation in key thematic areas
- ★ Inducement prizes or challenges with significant public outreach programmes designed to stimulate novel solutions to complex problems from new constituencies (such as the 'grand challenges' run by DARPA).
- ★ Time-bound programmes that bring together unusual combinations or partnerships in service of a particular problem.

Metrics of success:

Programmes tend to target radical transformation rather than incremental improvements. Possible outcomes include general purpose technologies which seed whole fields of commercial activity, with an example of this being DARPA's contribution to the development of GPS technologies.⁴¹

While the case studies we have looked at for this research can be mapped broadly onto the three agency types outlined above, we suggest that there is a fourth potential model that can be added to this emerging typology, drawing on elements of the approach taken by Market and System Fixers but with much greater scope for policy and programme experimentation, a more flexible and adaptable structure, and an explicit mandate to test out new ways of supporting innovation. We describe these as **System Optimisers**.



System Optimisers

Mission:

While the previous three models could be envisaged at several different stages of economic development, this final model represents an agency whose goal is to ensure continuous global competitiveness for an advanced innovative economy. The role of this agency would be to experiment with different policy and programme mixes to improve strategy and create more effective and enabling innovation systems.

Management:

- ★ They are unlikely to be responsible for large-scale programme delivery, instead testing and piloting models to be scaled by other delivery agencies.
- ★ System Optimisers likely to have the freedom to experiment with new ways of supporting innovation and growth – this could come either from a peripheral position in the innovation system, shielded from day to day political scrutiny, or it could come from a powerful mandate from leaders at the national level (if operating across the economy) or departmental level (if operating in a particular policy domain).
- ★ The staffing mix is likely to emphasise analysis and evaluation of what is and isn't working, as well as focus on the constant infusion of new programmes and ideas. Given the need to both evaluate the activities of the agency and analyse the national system's current situation and future trajectory, staff would likely be a mix of recruited industry leaders on secondment as well as highly-trained scientists, engineers and social scientists.

Methods:

System Optimisers may be able to orchestrate a combination of supply side (grants, subsidies, loans, skills development programmes and demand side (market shaping, regulatory) interventions. Other potential features of this approach:

- ★ Activities would tend to be direct and tailored versus indirect and general (e.g. grants and loans, rather than tax incentives).
- ★ An ability to quickly create partnerships with new actors and in new industrial sectors would be required, reinforcing the need to recruit key members of staff from industry or academia when and if needed.
- ★ The agency would likely need to coordinate across political and policy domains, for example, bringing together finance and education ministries.
- ★ A rich network of domestic and international experts would be required to help understand future technological and market trajectories, induce collaborative R&D ventures, and to generate new policy ideas.

Metrics of success:

Longer time frames and more qualitative indicators may be required to assess the success of a System Optimiser, if its aim is to increase the scale as well as the rate of innovation activities across the private sector. An example of this approach comes from the OCS in Israel, which sought to overcome bottlenecks in the Israeli innovation system through successive waves of policy experimentation. In the 1970s, this included developing a programme of conditionally-repayable loans to increase the level of R&D across the economy and setting up the BIRD Foundation to develop joint R&D projects between Israeli and American companies. In the 1980s and 1990s, following a 1984 law that greatly expanded the OCS' funding capabilities, the focus shifted to developing programmes and incubators that could help address identified issues relating to collaboration, and increase access to financing and mentorship in both the very early and rapid scale-up phases.⁴²

In setting out these models, we are not proposing that they are a set of exact templates to follow, or making value judgements about which approaches are 'best', since this will depend very much on context. Instead, we hope that our description of some of the dominant characteristics of existing innovation agency 'roles' will help governments to think about the kind of approach they most closely identify with, or would like to adopt. In the next section, we turn to some of the practical questions involved in designing an organisation capable of meeting these goals.

Part 3

HOW TO DESIGN AN INNOVATION AGENCY

Our review of government innovation agencies around the world has demonstrated the different ways in which these bodies can promote and induce business innovation and growth. But how can policymakers draw on these experiences and models to make choices about appropriate innovation agency design in their own contexts?

From our case study research, we observe that there are four key steps involved in the design and management of an innovation agency:

- ★ Identifying the right organisational **mission**.
- ★ Choosing effective **management** structures and skills.
- ★ Selecting the most appropriate set of **methods** and tools.
- ★ Establishing a set of **metrics** and measurements that will help the agency to understand and achieve impact.

However, before embarking on this process, it is vital that governments start by assessing and mapping the challenges and opportunities of their particular national innovation system. Questions to be investigated in this kind of mapping might include:

- ★ How developed is the country's innovation economy? Is it nascent, emerging, established, at risk of decline, or in need of intensive support to help sustain global competitiveness?
- ★ Where do national industries sit within global production networks?
- ★ How will the nature of the political system affect the choices that are made about innovation priorities and programmes?
- ★ What resources and capabilities are available to support the delivery of these programmes?

We do not investigate these issues in detail in this paper, but draw on the wider literature for an example of some of the indicators and factors that should be considered during the mapping process:

| | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Money</p> <p>The funds available to invest in infrastructure, new knowledge, absorptive capacity and innovation</p> | <p>Talent</p> <p>The human capital available to demand, develop, share and exploit new and existing knowledge</p> | <p>Knowledge assets</p> <p>Intermediary outputs of the innovation system that provide an indicator of its quality and potential, such as the quality of its research base</p> |
| <p>Structures and incentives</p> <p>The institutions and networks that determine how effectively the actors in the system work together to generate outcomes</p> | <p>Broader environment</p> <p>The economic and societal context with which the science and innovation system interacts, and the position of national domestic industries within global production networks</p> | <p>Innovation outputs</p> <p>Measurable outputs that can be used as proxies for the ultimate outcomes sought, such as particular economic and societal benefits</p> |

Notes: Adapted from Allas, T. (2014) 'Insights from benchmarking the UK's science and innovation system.' BIS Analysis Paper 03, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277090/bis-14-544-insights-from-international-benchmarking-of-the-UK-science-and-innovation-system-bis-analysis-paper-03.pdf

After a mapping of the underlying innovation system has been undertaken, the process of designing an innovation agency that can help to create opportunities and overcome challenges becomes more straightforward. Drawing on our analysis of the literature and the case studies, we turn now to propose a set of practical questions that policymakers should consider during this process.

Mission

1. What is the specific problem that needs to be solved?
2. Which types of beneficiary should the agency support to further its mission?

Management

3. How much autonomy does the agency require to design and deliver its mission?
4. What resources does the agency need to deliver on its objectives?

Methods

5. What kind of support should the agency provide?
6. What geographic level should the agency work at?

Metrics

7. What systems and processes should be put in place to understand outcomes?
8. How can the agency's overall value be judged?

Rather than producing a set of ‘right’ answers, we have drawn on examples from our case studies to illustrate the range of choices and options available to them depending on their specific mission. The following questions are intended more as a tool to guide national debates and decision-making processes than a step-by-step guide for all governments to follow. Our aim is to develop and refine them further through discussion with experts and governments around the world.

Mission

1. What is the specific problem that needs to be solved?

Innovation policymakers are often keen to emulate examples of institutions and programmes that have been successful in other countries. But before setting up a national innovation agency, they must be clear about the specific problem they are trying to address and design an organisation that will fit this purpose.⁴³

The decision to set up an innovation agency may be prompted by a variety of challenges. From our case studies, common reasons include:

★ **Low levels of investment in innovation in the business sector**

For example, in Israel, the rationale for establishing the OCS was to overcome an extremely low R&D to GDP ratio and to increase the small number (less than 1,000) of R&D workers with an academic education throughout the civilian sector. Accordingly, the mission of the OCS was initially defined as ‘maximisation of R&D activities in the national economy’.⁴⁴ Addressing this type of challenge would require an agency operating as a Market and System Fixer.

★ **A desire to generate new sources of economic competitiveness**

For example, ITRI emerged from a government desire to drive Taiwan’s economic modernisation through the creation of specific new industries. Addressing this type of challenge would require an agency operating as an Industry Builder.

★ **Addressing major societal issues through the development of technological solutions**

In the US, DARPA was created to give the country a decisive strategic edge by helping to develop new technology-based military innovations. Addressing this type of challenge would require an agency operating as a Mission Driver.

While the establishment of an innovation agency may be part of the solution to each of these problems, different missions will prompt the creation of quite different types of institution in terms of the criteria for success, beneficiaries, budget, management structures, the types of expertise held within the organisation and the methods and instruments used.⁴⁵

This suggests the need to be focused in selecting the agency’s mission. As discussed in earlier sections, an innovation agency will often adapt and evolve over time in response to different needs and opportunities. But an agency that is trying to pursue too many different objectives at once will find it difficult to establish a clear sense of purpose and a portfolio of programmes that combine to form more than the sum of its parts. It also risks spreading its resources too thinly and failing to deliver on any of its objectives.

2. Which types of beneficiary should the agency support to further its mission?

Innovation agencies need to determine whose capabilities they are aiming to transform in order to achieve their mission, and where their investments can generate the greatest public and private returns.

From the case studies, we observe that innovation agencies around the world support different types of beneficiary, and that success is more likely to occur when these partners are matched with the agency's overall mission and existing levels of development within supported industries. For example, after a stage in which ITRI's official strategy was to spin-off new anchor companies and develop the semiconductor industry, it changed its mode of cooperation with industry, preferring to organise research consortia and work with many different chip design companies instead of focusing on grand projects. This occurred both in response to the growing maturity of the industry, and the changing priorities of successive leaders within ITRI.

Common beneficiaries of innovation agency support include:

- ★ **Private sector intermediaries** that support innovation, such as business incubators or accelerators
- ★ **Public sector intermediaries**, such as 'competence centres' that promote innovation collaboration between businesses, researchers and public bodies
- ★ **Individual entrepreneurs or startups** that do not have well-developed networks or access to private sources of investment
- ★ **Small businesses** that are more likely to be financially constrained, could benefit directly from relatively small injections of resource and whose activities could have an indirect impact on bigger firms by creating new sources of innovation and competition
- ★ **Large businesses** that can use public subsidies to increase the scale of R&D or innovation activities currently underway, or to work in partnership with research organisations or other businesses
- ★ **Research organisations and academic institutes** developing new ideas or technologies which may have commercial or wider societal benefit

Across our ten case studies, we have observed a trend towards innovation agencies increasing the proportion of spending on startups and small businesses. For example, while CORFO in Chile supports all types of business, in recent years its focus has been on high-growth-potential SMEs, which were revealed to be particularly vulnerable during the Asian financial crisis at the end of the 1990s. Innovate UK, VINNOVA and Tekes also now direct more than half of the budget they spend on companies towards SMEs. For Innovate UK, this represents a considerable shift from its first few years of operation, when big companies were the focus of its funding schemes.

The challenge here is working out where an innovation agency's support can have the greatest impact. Some scholars have argued that the greatest economic benefits occur during the scale-up phase, when high-growth firms rapidly increase both employment and revenue.⁴⁶ This suggests that while start-ups and small companies are important, they should not necessarily be the only beneficiaries.

Management

3. How much autonomy does the agency require to design and deliver its mission?

Evidence from our case studies suggest that agencies engaging in longer-term or higher-risk forms of innovation support tend to benefit from having more freedom from government to set strategy, design programmes and allocate budget, while agencies designed to implement specific government programmes will likely need closer relationships with their government sponsors.

Analysis by academic experts suggests that the most ‘radical’ development agencies tend to sit on the periphery of the public sector, with considerable freedom to test out new ways of supporting innovation and relatively little direct control from government.⁴⁷ This model seems to have worked well in the past for agencies experimenting with riskier policies or investing in breakthrough technologies, such as the OCS and DARPA. Uri Gabai, Director of Strategy and Economic Research at the OCS, claims that the organisation’s independence and the ‘ethos of success’ that emerged around its early investments allowed it to build up ‘high walls’ between itself and its sponsoring Ministry and gave it the authority to play a shaping rather than an implementing role in the development of Israel’s innovation strategy.⁴⁸

However, this approach will not necessarily be appropriate for an innovation agency that is responsible for delivering a specific government programme, where there is a clear expectation of high returns on investment, or where innovation has become a salient public and political issue.⁴⁹ A good example of the former is CORFO in Chile, which was established in 1939 to improve national energy supply and to establish a domestic steel industry. Its mission has shifted many times over the years in response to changing government initiatives, but it has remained generally focused on the design and implementation of instruments and programmes, while other Ministries set the direction of policy.

There are ‘hybrid’ options between these two extremes. For instance, Austria’s FFG is a private company ‘co-owned’ by two government ministries - the Federal Ministry of Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Science, Research and Economy (BMWFW) - and its work falls under two ‘pillars’. Programmes funded by the BMWFW and other Ministries tend to be directed towards particular government policy objectives, while FFG’s management have more control over strategy and spending for programmes funded by the BMVIT. Meanwhile, some agencies such as FINEP and ITRI are able to generate their own revenue in addition to the budget they receive from government, which gives them more capacity for discretionary spending. Revenue generation can be a double-edged sword though, as it can tempt government to reduce overall budgets.

4. What resources does the agency need to deliver on its objectives?

Different types of organisational mission require different types of resources, both in terms of budget and skills. While organisations with larger budgets can invest in more projects, it is most important that an innovation agency has the resources it requires to deliver on its specific objectives, and the expertise to be able to manage these programmes effectively.

Our case studies suggest that there is no ‘ideal’ size of budget for an innovation agency. DARPA is a clear outlier in terms of the amount it spends annually; with a budget of nearly \$3 billion (and individual projects up to \$100million), it has the ability to support very large-scale projects that aim to develop new and breakthrough technologies. Yet having a smaller budget is not necessarily a barrier to delivering on organisational objectives. At the other end of the scale is the CTI in Switzerland, which spends around \$165 million a year. Yet the agency can point to a number of clear success stories in terms of the companies it has helped through activities such as mentoring and coaching.⁵⁰

Related to this, innovation agencies need to think carefully about the capabilities and skills that will allow them to administer programmes effectively. For instance, agencies that provide more responsive funding need to be able to assess the technological and commercial feasibility of projects presented to them in many different sectors. These skills may be held in-house. For example, Innovate UK primarily employs technical specialists or those with industry experience who can judge the commercial potential of R&D projects in different sectors. However, expertise can also be sourced externally. For example, the CTI in Switzerland and OCS in Israel both use a panel of external experts drawn from academia and industry to make decisions about which projects will receive funding.

Agencies wishing to develop new industries are more likely to need deep knowledge of specific subjects, and sometimes even the capacity to conduct commercial R&D activities themselves; even if just to be able to judge whether this technological specialism is likely to enhance national competitiveness. A good example of this is Taiwan's ITRI, which primarily employs engineers and technical experts to conduct applied research projects and spin out new companies that can commercialise the findings.

Methods

5. What kind of support should the agency provide?

As we have found in our case studies, innovation agencies generally stimulate business innovation in the following ways: lowering uncertainty and risk by providing them with direct R&D funding; giving them access to new skills and knowledge; investing in the intermediaries that support businesses; or helping to build networks that encourage collaboration and knowledge-transfer. The specific mechanisms for delivering this support should be determined by the kind of innovation that is desired, where it makes sense for an innovation agency to intervene in the process, and what kind of return is expected.

Some of the key considerations in identifying the most appropriate methods and tools for an innovation agency include:

- ★ Whether support will primarily be **targeted** at specific challenges or **responsive** to industry needs

Innovation agencies that aim to solve a particular challenge or stimulate the emergence of new industries or capabilities (Mission Drivers or Industry Builders) are more likely to target specific types of innovation. Sometimes these are 'pushed' from the top down. For example, ITRI in Taiwan spent its first few decades of existence investing in activities to build an indigenous semiconductor industry. Later, under different presidents who held PhDs in material science and biology, more effort was focused on these areas. Alternatively, innovation agency funding can be used to 'pull' demand, whether through challenge-driven programmes (an approach that VINNOVA has pioneered) or through pre-commercial procurement schemes (like the Small Business Research Initiative managed by Innovate UK,⁵¹ modelled on the US SBIR programme).

In comparison, innovation agencies that play more of a Market and System Fixer role will often take a more responsive approach to funding. For example, in its early years, the main objective of the OCS in Israel was purely to increase the intensity of business R&D. As such, the agency did not concern itself with specific sectors or technologies, as long as its funding resulted in the creation of new science-based products that could be exported. Tekes in Finland currently reserves around 40 per cent of its budget for 'reactive' funding, supporting projects that are judged to have merit but do not fit into a particular thematic programme.

★ The balance between **early-stage support** and **late-stage interventions**.

Looking across our case studies, we see that most existing innovation agencies focus their efforts on funding or support that will help businesses to develop, prototype, trial and start to scale-up ideas or technologies with commercial promise. In doing so, they fill the gap between pure 'discovery oriented' funding often provided by science or research funding agencies, and very late-stage commercial funding that will often be provided by private investors.

However, some agencies offer support for activities that are much earlier or later in the innovation process. An example of this is the FFG in Austria, which funds activities across the entire 'Technology Readiness Level' spectrum (encompassing very early-stage idea generation, through the development, testing and piloting of new innovations, right up to the point where commercialisation is imminent).⁵² For example, its BRIDGE Early Stage programme⁵³ focuses on giving non-refundable financing to cooperative projects that combine high-level scientific research with a commercialisation perspective, while its Markt. Start programme⁵⁴ gives low-interest loans to SMEs to help them launch new products and service innovations into the market.

★ The **public return on investment** that is desired

An ongoing debate relates to whether government should expect to receive a share of the profits generated by businesses as a result of the support they receive. This issue is particularly acute in countries where public finances are limited and there are high levels of political scrutiny of what is being spent. Some existing innovation agencies, including Innovate UK and VINNOVA, currently distribute most of their funding in the form of non-repayable grants. But in these countries and elsewhere, there is increasing interest in the approach taken by innovation agencies with a more diverse portfolio.

For example, in 2012 the French government established a new body to provide financial support to entrepreneurs for R&D, commercialisation and export activities. Bpifrance, which describes itself as a 'public investment bank', uses a wide range of financial instruments, including low and zero interest loans, reimbursable and non-reimbursable grants for innovation, subsidies, tax credits, long-term loans, bank guarantees, equity, convertible bonds and co-investment alongside national and regional private funds.⁵⁵ However, caution is advisable, since taking equity stakes in companies carries the risk of changing the way the agency is evaluated (both internally and externally) and shifting it away from innovation-inducing to profit maximising behaviour.⁵⁶

Tekes provides low-interest development and piloting loans (often in combination with initial and follow-on grants) to help companies test new products or services, production methods and business models. Loans are typically used in projects where the commercialisation of the product is imminent, although as noted by Petri Lehto in Finland's Ministry of Economy and Employment, *"if we'd like Tekes as an agency that is promoting radical innovation it would need to emphasise the importance of grants...when you're close to the market you know what to expect. There's less risk. But with grants you're able to see a bit more towards the distance"*.⁵⁷

The OCS takes a different approach. Typically the agency will provide up to half of the project's costs for established companies (and a higher proportion for startups), with a royalty fee to be paid back only if the project results in actual sales. This revenue model has been successful in raising funds that are then put back into the organisation. However, there is no set target for the return expected on this investment.

It is important to note that repayable forms of support tend to be directed towards lower-risk projects that have a high chance of being commercialised. Yet as discussed above, innovation agencies need to think carefully about how they can provide support that is not forthcoming

from other sources. This point was made powerfully by the current Director of Israel's OCS, who stated that if 70 per cent of the organisation's grants were fully repaid, he would view this as an institutional failure, since it would indicate a lack of risk-taking and crowding out of private sector investment.⁵⁸

6. What geographic level should the agency work at?

An innovation agency's mission will shape where it positions itself within the national innovation system, geographically as well as politically.

Different missions require different ways of working. For innovation agencies that aim to develop solutions to major economic or societal challenges, a more centralised approach may be most effective. This has been the approach of DARPA, which works primarily at the national level with government and the US military to deliver its programmes. In comparison, innovation agencies that seek to play the role of a Market and System Fixer, or to create clusters of innovative businesses, may find it more useful to have a regional presence. For example, both Tekes and ITRI have branch offices or campuses in different parts of the country that help them to address local needs and develop regional 'clusters' of research and innovation intensity.

Some innovation agencies also get involved in connecting national businesses to international partners or investors. For example, Innovate UK, Tekes and the CTI all run overseas 'missions' for entrepreneurs and high-growth-potential businesses to help them find opportunities for joint projects or investment. Some agencies have even set up dedicated offices to encourage R&D collaboration in key target markets. This has been a consistent strand of ITRI's work, which invested a lot of time and resources during its early years in creating strategic partnerships with US companies and researchers that would give it access to expertise and help with building up Taiwan's indigenous semiconductor industry.

Measurement

7. What systems and processes should be put in place to understand outcomes?

It is relatively straightforward for innovation agencies to collect data on inputs and outputs, but much harder to demonstrate the long-term outcomes and impacts of their programmes. A priority is therefore designing a set of evaluation metrics and tools that will allow it to make ongoing assessments about the effectiveness of interventions that may not lead to immediate results.

Monitoring and evaluation has been growing in importance for all innovation agencies, although for many this is an area of significant under-investment in the past. One of the main challenges that all agencies face is designing an evaluation system that helps to steer the course of programmes and enable 'course corrections' along the way, rather than waiting until they are complete. This has recently been a priority for Innovate UK – their Evidence and Economics team is looking for ways to link to other national datasets, and better understand the impact of the agency's interventions.

A number of agencies, including Innovate UK and Tekes, have also come together into a new global collaboration (the Innovation Growth Lab) to explore how they can become more experimental with their programmes and use tools such as randomised trials to find out what actually works, when and for whom.⁵⁹

There are different indicators that innovation agencies can use to help understand the impact of their interventions. These generally fall under two categories:

- ★ **Outputs** - including the numbers of businesses supported, the number of new jobs created as a direct or indirect result of the innovation agency's funding, IP or patents developed as a result of business R&D projects, or the creation of new partnerships and collaborations.
- ★ **Outcomes** - including longer-term assessments of changes in the economy or society as a result of the agency's interventions, the emergence of new industries or clusters of businesses, higher levels of business investment in R&D, and changing attitudes and behaviours around innovation. Tekes is a leader in this type of evaluation, assessing the projects it supports at the point when funding is applied for, at the end of the project, and a few years after completion to identify follow on impacts. This has enabled it to assess the contribution that the agency's funding has made to the development of particular innovations. However, there remains a desire to improve the way that Tekes measures the broader social impacts of its work. As we were told by Christopher Palmberg, Program Development Manager at Tekes, though the agency believes that they are creating a lot of societal spill overs, *"these are extremely hard to validate... that's one of those challenges for agencies - how to make such activities impactful and also measurable"*.⁶⁰

It is inherently difficult for innovation agencies to assess the extent to which they can attribute successes directly to their activities, especially for complex programmes that are often delivered with a range of other stakeholders. This is a challenge facing most organisations or actors charged with stimulating innovation, and should be taken into account when judgements are made about the overall performance of an innovation agency.

8. How can the agency's overall value be judged?

Innovation agencies are often judged quantitatively, in terms of the returns generated by their investments, but this is only part of the potential value that they add. Equal effort should be put into assessing more qualitative factors linked to how well an agency is managed its ability to take (and learn from) risks, and the skill with which it implements programmes.

When asked to assess the systemic influence that their organisation has had, innovation agencies tend to draw on two types of evidence: individual success stories or quantitative programme assessments. Some point to very clear outcomes of specific interventions, such as DARPA's involvement in the development of GPS and the Internet, or early investments made by innovation agencies in businesses that went on to be very successful, such as Tekes' long-term support for the Nokia corporation. Others use econometric tools to estimate the impact generated by individual programmes or a portfolio of activities, even if the analysis is not always very rigorous and doesn't lead to robust conclusions. However, these two indicators cannot always give the whole picture of an agency's impact, or serve as a useful guide for others to follow.

In assessing the overall contribution that an innovation agency is making within the innovation ecosystem, there are a number of factors that our case study research suggest it would be useful to take into account:

- ★ **What is distinctive about the innovation agency's offer.** Depending on the role that an innovation agency is performing – whether it is a Market and System Fixer, an Industry Builder, a Mission Driver or a System Optimiser – a useful way of thinking about impact is to look at whether it is supporting domains and projects for which there are very low levels of private investment. Otherwise, it might be the case that even successful programmes (in terms of company growth or profits) are channelling resources to projects that would have access to them without public support. Since innovation agencies aim to increase innovation in areas that otherwise would have been neglected, the right evaluation methods should be used to measure this appropriately.

- ★ **How much risk the agency is taking.** Since much of what innovation agencies do is experimental, we should expect a high rate of failure, not only in terms of individual projects that are supported, but also in terms of entire programmes. Indeed, an important part of the evaluation process should be to gauge whether the agency takes enough risk, and if it is quick enough to both recognise failed initiatives and close them down, while scaling-up those that have proved their worth.
- ★ **The innovation agency's influence and leadership with respect to innovation policy and programmes.** The interviews we conducted with experts and representatives of our case study agencies suggest that much greater effort needs to be put into judging the effectiveness of the agency as a whole. This depends greatly on fluid factors such as the political prestige associated with an innovation agency, the quality of its management teams and processes, the success with which it executes its programmes and how is perceived by the beneficiaries of its support.

All of these factors are hard to measure, and there is no one set of metrics that will apply to every organisation. But without greater investment in this kind of qualitative evaluation, innovation agencies will continue to find it hard to articulate the unique value that they add to the mix of other policy instruments used by government to support business innovation, and get better at performing this role.

CONCLUSIONS

At the time of publishing this report, many existing innovation agencies are undergoing significant strategic and structural changes.

In January 2016, a law was passed in Israel that approved the transformation of the OCS into a National Authority for Technological Innovation. When it is fully established, this body will have more freedom than its predecessor to launch creative funding tracks and set guidelines that will determine the licensing and transfer of any resulting technology, as well as the freedom to tackle societal issues.⁶¹ The CTI in Switzerland is facing a similar shift, with laws currently being enacted that will allow it to operate on a much more equal footing with the Swiss National Science Foundation (SNSF) - the scientific research funding agency mandated by the Swiss Federal Government.

Other innovation agencies are thinking about new ways they could provide support to businesses (for example, Innovate UK is set to start providing more loans and other repayable forms of financing over the next few years as a result of shifts in political expectations about the return the agency should deliver), while some are thinking about how to make do with considerably reduced budgets (for example, Tekes is starting to divest itself of responsibility for the management of its SHOK Competence Centres, following substantial cuts in its annual allocation from government for the 2016 financial year).

These developments reinforce one of the most important findings of our research: that there is **no single picture of what a 'successful' innovation agency looks like**. In our case studies we have not been comparing like with like, which suggests that determining what model will be best in a given country can only result from a detailed mapping of the specific context. There is much to learn from other countries about what works in terms of management, methods and approaches to measurement. But attempts to directly replicate an innovation agency that has a very different mission or operates in a different political or economic context are likely to fail.

If there is no one ideal type of innovation agency, **there are a number of models that can help to guide policymakers** when they are determining what kind of approach and structure will fit their national context, resources and ambitions. From our case studies we have identified four potential models to use as the starting point for a broad typology:

- ★ Market and System Fixers;
- ★ Industry Builders;
- ★ Mission Drivers; and
- ★ System Optimisers

Whatever approach an innovation agency takes, it is vital that they **define their mission very clearly from the outset, and do not try to pursue lots of different objectives at one time**. This is vital if the agency is to develop a distinctive identity and a clear 'offer' to both government and the beneficiaries of its support. It also enables it to develop a vision of what long-term success looks like, and how it can adapt and change course **to respond to new needs and opportunities** without deviating too much from a desired end-result. Otherwise, innovation agencies run the risk of constantly changing both their programmes and their vision, increasing uncertainty for entrepreneurs and companies instead of reducing it.

To manage these strategic transitions well, **innovation agencies need a considerable amount of autonomy and an ability to follow through on longer-term interventions.** They also need to be judged both quantitatively and qualitatively, with metrics that capture not only the value for public money that their activities represent, but also **the quality of their management, their ability to take (and learn from) strategic risks, and the skill with which they design and implement their programmes.**

This kind of evaluation is not easy, but crucial for organisations whose purpose is to invest in high-risk and potentially long term ventures. As our case studies show, successful innovation policies, even those that culminated in a rapid transformation of the economy as in Taiwan, Finland and Israel, were developed and perfected over the course two decades or more, before the tipping point that caught the public imagination occurred.

A final point to be made is that **innovation agencies are not a panacea for all the problems a country faces in terms of encouraging business innovation and growth.** As our case studies show, they can be extraordinarily successful in terms of achieving particular goals – whether this is funding the development of entirely new technologies, seeding new industries, or filling funding gaps that would otherwise prevent the commercialisation of scientific research findings. Yet they are just one among a number of innovation policy levers, and they evolve and change along with government priorities, even as they have the simultaneous capacity to shape them. Understanding this process of ‘co-evolution’, and setting realistic expectations for what these agencies can accomplish with the resources they possess, is one of the most important things that a government can do to help ensure that whatever innovation agency they design is able to fulfil its potential.

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Austria

FFG

SUMMARY

The Research Promotion Agency (FFG) is the national funding agency for industrial research and development in Austria, offering a diverse portfolio of support programmes to Austrian businesses and public or private research organisations. Every year, FFG supports around 3,200 projects, involving over 5,500 partners.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|--------------|------------------|---------------------|------|
| Vienna | 2004 | €592 million (2015) | 275 |

GOVERNANCE

Private limited company owned by the Austrian Federal Government, with shared ownership from the Federal Ministry of Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Science, Research and Economy (BWF).

AIMS

To promote research, technology, development and innovation for the benefit of Austria, make a lasting contribution to the strength of the Austrian economy and help Austria's business and science sectors to remain competitive both nationally and internationally.

COUNTRY PROFILE



GDP

US\$436.3 billion (2014)⁶²

GOVERNMENT SPENDING ON R&D

1.09 per cent of GDP (2013)⁶³

BUSINESS SPENDING ON R&D

1.98 per cent of GDP (2012)⁶⁴

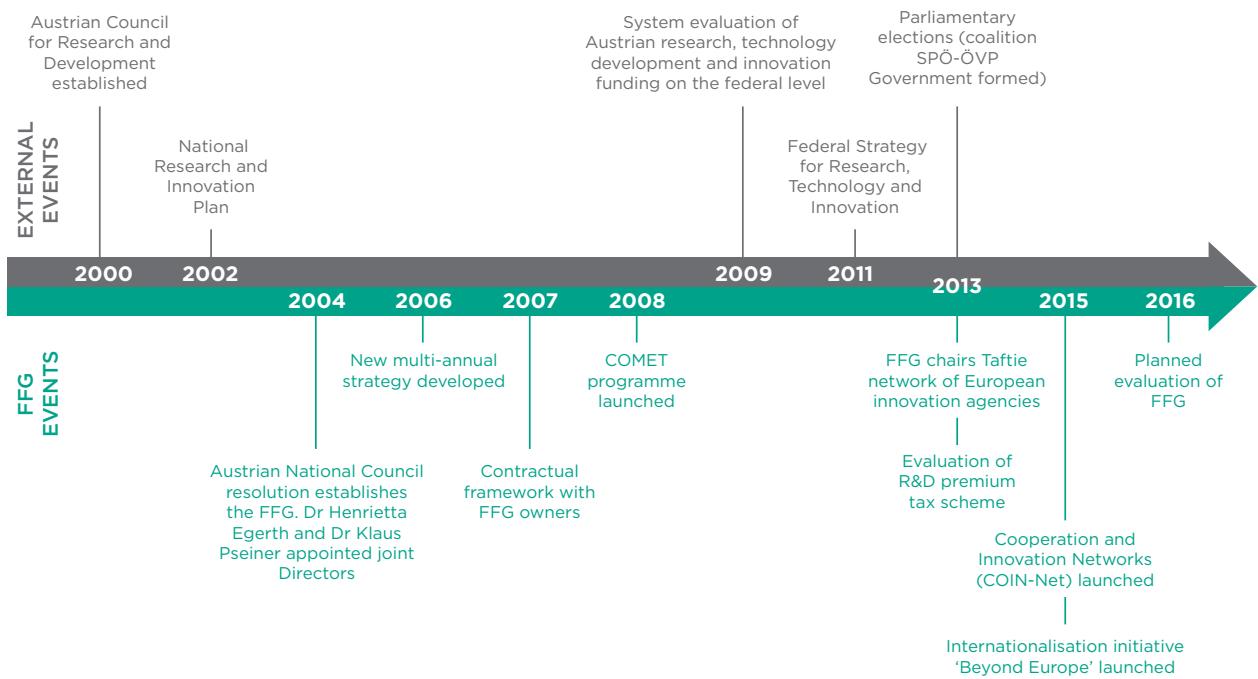
WHAT MAKES FFG STAND OUT?

- ★ **Bridge between national and federal innovation support.** Before FFG was created, the Austrian innovation funding system was very fragmented. One of FFG's key aims is to improve the links between regional and national innovation policies and funding, and it now helps to coordinate the innovation activities of Austria's federal governments.
- ★ **Substantial international portfolio.** The FFG has recently engaged in an increasing number of international activities, from coordinating EU initiatives to developing a new fund to encourage and multiply R&D collaboration between Austrian organisations and non-EU countries.
- ★ **Dual role in designing and delivering strategy.** The FFG is organised around two main pillars. One encompasses relatively autonomous programmes, partly funded by BMVIT, where FFG plays a strategic role. The other consists of programmes conducted on behalf of other ministries, in which FFG plays more of a delivery than a design role.

MISSION AND HISTORY

FFG was created in September 2004 to act as the national funding agency for industrial research and development in Austria. It was formed from the merger of four pre-existing institutions: the Industrial Research Promotion Funds (FFF), the Technology Impulse Agency (TIG), the Bureau for International Research and Technology Cooperation (BIT) and the Austrian Space Agency (ASA). This consolidation was designed to create one large player in the field of applied research and innovation funding in Austria that would act as a single point of contact for funding target groups, as well as serving as a governmental advisory body for international and EU research programmes.

As a result of regular strategic reviews (which take place every three years) FFG has evolved from being primarily a funding agency to being more of an enabling agency. Its portfolio now includes more advisory services, and it has developed a set of thematic and structural programmes to target specific innovation areas. It has also sought to play more of a connecting role within the Austrian innovation system and build links with the state governments. FFG’s budget has grown since it was created, but not steadily across the period. While the budget increased consistently between 2004 and 2008, rising from €316 million to €652 million, it then dropped back to €429 million in 2010, only to increase again in 2015 to €592 million.



MANAGEMENT



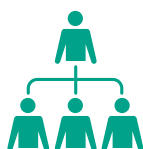
RELATIONSHIP WITH GOVERNMENT

FFG is owned equally by two government ministries: the Federal Ministry for Transport, Innovation and Technology and the Federal Ministry of Science, Research and Economy. The model of a private limited company was chosen as it was felt that this would encourage the development of more professional management structures. FFG has two main organisational pillars. The first is a relatively autonomous set of funding and support programmes (including the General Programmes). This pillar is ‘managed’ by the BMVIT, but FFG’s Managing Directors make decisions about strategy and budget. The second pillar consists of projects and programmes conducted on behalf of different ministries (varying across sectors) or of other organisations in the Austrian system: for these initiatives, the relevant Ministry will decide on the allocation of budget.



INSTITUTIONAL NETWORK

FFG’s main tasks are to manage projects and promote collaborations that will increase Austria’s competitiveness. As such, the agency’s most important institutional relationships have tended to be located within government, although there have been some shifts over the past few years. Austria’s länder (states) have historically had quite different innovation strategies and have not communicated or coordinated these very effectively. FFG has explicitly sought to address this challenge, and several of the organisation’s programmes now include direct cooperation between government levels and a mix of federal and state funding. In the last two years, FFG has also started running entirely regional programmes, directly commissioned by the state governments. According to Michael Binder, who sits within the FFG Strategy Unit, the agency now aims to act as a “service agency for the länder.”⁶⁵



ORGANISATIONAL DESIGN

FFG has nearly doubled in size since it was set up, from around 150 people in 2004 to around 275 currently. Its operating structure is closely connected to the programmes it runs, with most of its internal capacity directed towards the General Programmes, Structural Programmes, Thematic Programmes and European and International Programmes. These units have between 40 to 55 members of staff each. FFG also has its own small, internal, strategic think tank, tasked with developing new policies for the organisation and interfacing between management and the programmes.



SKILLS AND EXPERTISE

FFG members of staff have a range of backgrounds, including individuals with knowledge of the thematic areas that the organisation focuses on, technical specialists, and those with expertise in finance or economics. The agency’s recruitment strategy generally aims to bring in people with some experience of working in industry (apart from in the European and International Programme, where staff are more likely to have purely academic backgrounds). There is no dominant ‘type’ within FFG, although there are very few employees with a civil service background.




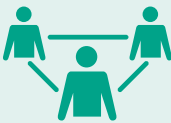
METHODS

APPROACH

FFG currently offers 30 different support programmes, divided into five broad categories: General Programmes, Structural Programmes, Thematic Programmes, European and International Programmes and the Aeronautics and Space Agency. FFG-supported projects cover a broad range of the Technology-Readiness Level (TRL) scale, from discovery-oriented projects (Levels 1-2) up to projects closer to commercialisation (Levels 7-8). About 30 per cent of FFG’s funding is allocated via thematic priority calls, 50 per cent through bottom-up open calls and 20 per cent through structural programmes. Support programmes fall under an array of themes, including life sciences, information technology, energy and environment, mobility, space, safety and security, and human resources.

BENEFICIARIES

Beneficiaries of FFG support include Austrian companies, not-for-profit organisations, research institutions, universities and individual researchers. FFG support requires organisations to commit match-funding. Around 70 per cent of FFG’s total funding is directed to R&D projects run by companies (three-quarters of which take the form of grants). FFG focuses particularly on SMEs: these receive 80 per cent of the funding FFG makes available for companies.

| TYPE OF SUPPORT | | KEY PROGRAMMES |
|-------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial |  | <p>General Programme: FFG’s flagship open call programme uses a mix of grants, loans and guarantees to support the R&D and entrepreneurship activities of Austrian companies.⁶⁶</p> <p>Innovation Voucher scheme: grants of up to €5,000 or €10,000 for Austrian SMEs to buy in R&D knowledge or support.</p> |
| Non-financial |  | <p>Research and Development Premium: a 12 per cent R&D tax premium for companies selected by FFG.</p> <p>FFG Academy: permanent training scheme to enhance the participation of Austrian actors in European funding programmes.</p> <p>FFG is the Austrian contact point for several European initiatives (including EUREKA, ERA-NET, and the Enterprise Europe Network).</p> |
| Support for intermediaries |  | <p>AplusB programme: funds centres that offer professional support for scientists in turning their ideas into commercially viable businesses.</p> <p>COIN:⁶⁷ networks designed to encourage technology transfer within entrepreneurial cooperation schemes.</p> |
| Connecting and institution-building |  | <p>COMET Competence Centers: network of 21 centres that develop research competencies in the field of science-industry cooperation.</p> <p>Beyond Europe: a €5 million call for R&D projects conducted with partners in non-EU countries, launched in 2015.</p> |

EVIDENCE OF IMPACT

For each new programme, FFG is required to set out target groups and programme goals, and to develop an evaluation plan that sets out common measures for success. There is no cross-organisational model for these evaluations but, depending on the duration of the programme, there are usually interim and ex-post or end evaluations. Evaluations have generally been used to optimise existing programmes, rather than as a tool to set budgets and decide which programmes should be scaled up or down. However, FFG is currently carrying out an internal portfolio review, analysing the support it provides and trying to judge whether its programme and instrument mix is appropriate for Austria's challenges and the priorities set by the Austrian government.

For the last 40 years, the Austrian Institute for SME Research⁶⁸ has conducted an annual impact monitoring of funding given out by FFG (and its main predecessor organisation FFF). Impact is measured through a survey of previous programmes' beneficiaries, four years after completion of the project, in which companies are asked a series of questions on topics like turnover, employment, partnerships or research activities. Since 1968, FFF/FFG's General Programmes have funded 27,000 research projects. External and internal evaluation reports have shown the generally positive impact FFG has had on Austria's business and innovation systems:

- ★ FFG estimates that for every €1 invested in research, companies have recorded a long-term additional turnover of €12, leading to the creation of more than 10,000 jobs between 2004 and 2013.⁶⁹
- ★ FFG's European and International programmes provide information and support to more than 30,000 individuals (of which 40 per cent are from industry, 29 per cent are from universities, 11 per cent are from non-university research units and 20 per cent are from other types of organisations).
- ★ Around 2,000 projects in the 7th European Union Framework Programme included Austrian companies, representing research funding of about €800 million.⁷⁰

INFLUENCE IN AUSTRIA'S INNOVATION SYSTEM

FFG is generally thought to have had a positive impact on the Austrian business support landscape, although it is acknowledged internally that there is more work to do to improve the organisation's portfolio and to increase its focus on the innovation system as a whole, rather than individual programmes. Over the last few years the organisation has aimed to professionalise its processes, making it a more effective 'one stop shop' for companies and researchers looking for support for applied research projects. For example, FFG now has harmonised application forms through an electronic submission system. This drive has also enabled FFG to improve communication and coordination in the field of innovation and applied research between federal and state organisations and government, which has historically been very fragmented.⁷¹

Its role as an informal consultant to the Austrian government on science, technology and innovation policy has expanded over time, even though this is not formally part of its mission. FFG provides supporting data and information via its EU performance monitoring portal and reports on thematic priorities. FFG was involved in the development of the federal research, technology and innovation strategy that was launched in 2011, and is involved in strategy processes around themes like open innovation, open access, open data and intellectual property.



Brazil

FINEP

SUMMARY

The Financiadora de Estudos e Projetos (FINEP) is Brazil’s national innovation agency. It is a government-owned institution that sits under the Ministry of Science, Technology and Innovation (MCTI) and aims to transform Brazil through innovation.⁷²

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|------|
| Rio de Janeiro | 1967 | US\$2.1 billion (2014) | 740 |
| GOVERNANCE Public company managed by the Ministry of Science, Technology and Innovation (MCTI). | | | |
| AIMS To promote the economic and social development of Brazil through public support for science, technology and innovation in companies, universities and technological institutes. | | | |

COUNTRY PROFILE



GDP

US\$2.35 trillion (2014)⁷³

GOVERNMENT SPENDING ON R&D

0.63 per cent of GDP (2010)⁷⁴

BUSINESS SPENDING ON R&D

0.56 per cent of GDP (2010)⁷⁵

WHAT MAKES FINEP STAND OUT?

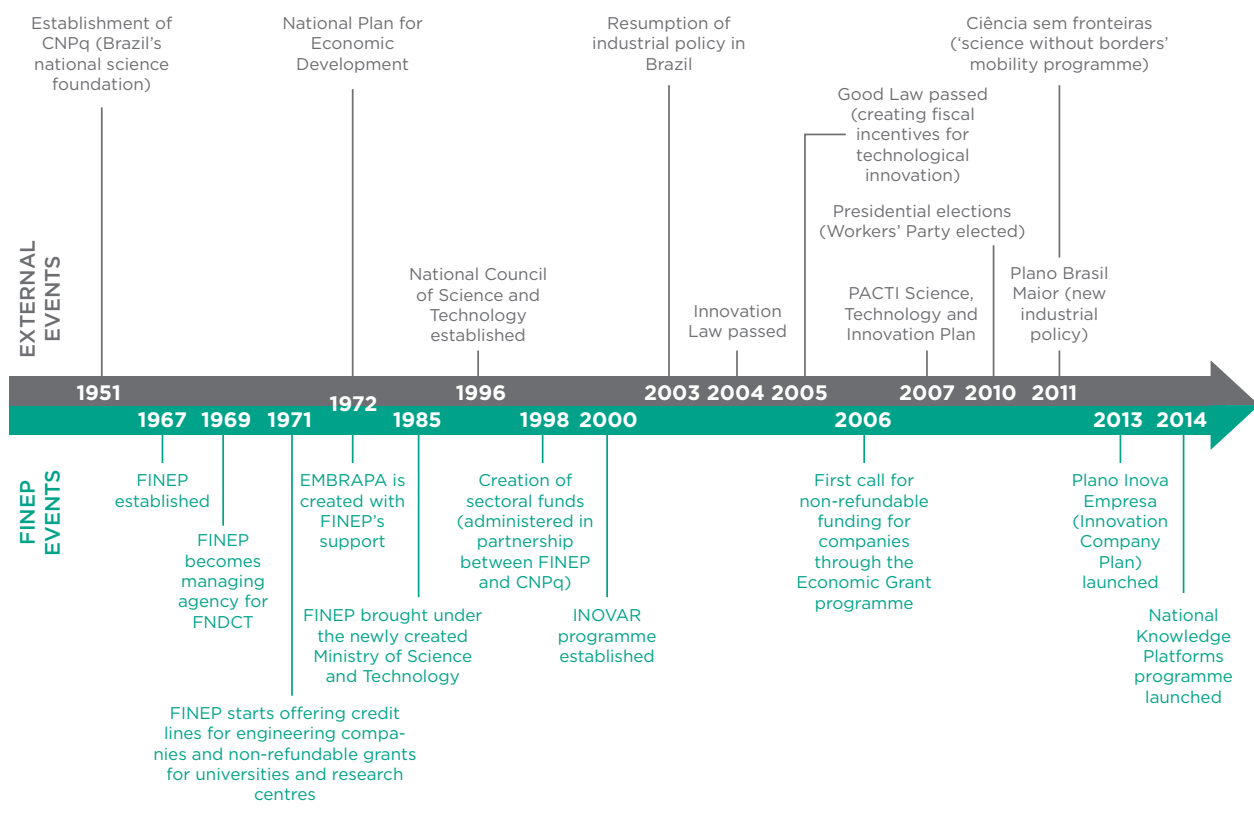
- ★ **Coordination role within the Brazilian innovation system.** FINEP led the design of Plano Inova Empresa, Brazil’s ambitious innovation and technology strategy. Launched in 2013, it aims to increase R&D in strategic sectors and is the result of cooperation between 12 ministries, four federal regulatory agencies and the Brazilian Development Bank.
- ★ **Revenue-generation capacity.** FINEP was established as a public company under the ownership of the Ministry of Science, Technology and Innovation. While FINEP is not autonomous from the government, it has started developing programmes that will enable it to achieve greater financial independence, and it has the capacity to generate its own profits through returns on investment.
- ★ **A focus on internal capacity-building.** In addition to supporting staff undertaking Masters or PhD degrees, FINEP launched an internal training programme in 2013 covering topics such as innovation policy and economic affairs. FINEP aims to tailor these training offerings further and open them up to external partners, including companies and the civil service.

CASE STUDIES BRAZIL: FINEP

MISSION AND HISTORY

FINEP was set up in 1967 as a public company, institutionalising a pre-existing trust fund for research projects and programmes created in 1965. In 1969, FINEP became the managing agency for FNDCT, the National Fund for Scientific and Technological Development.⁷⁶ It was initially created to work with the Ministry of Planning and during its first three decades, FINEP’s funding was particularly focused on academic institutes and research centres. In 1985, FINEP was linked to the newly-created Ministry of Science and Technology. This coincided with the start of a decade of adjustments and budget constraints in Brazil. The 1980s were nicknamed the ‘lost decade’, with a stagnant GDP (no increase between 1984 and 1989) and inflation rates reaching almost 3,000 per cent by 1990.⁷⁷

Efforts to improve the innovation ecosystem started during the 2000s, when FINEP established the INOVAR project to help build a Brazilian VC ecosystem.⁷⁸ The 2004 Innovation Law and 2005 Lei do Bem (Good Law) made direct public funding to firms possible for the first time, while the 2007-2010 PACTI plan under President Lula incorporated the concept of innovation fully into science and technology policy.⁷⁹ Brazil’s 2011 Industrial Policy plan encouraged a greater focus on sectoral strategies. The launch of the 2013 Plano Inova Empresa⁸⁰ (jointly developed by FINEP and BNDES) marked the point at which FINEP began operating integrated support instruments for firms (including credits, grants, and equity). Its current priority sectors include energy, biofuels, cleantech, health and welfare, agriculture and space.



MANAGEMENT



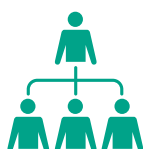
RELATIONSHIP WITH GOVERNMENT

FINEP is a public company owned by the Ministry of Science, Technology and Innovation. This status gives it considerable freedom to set its own strategy and determine how its budget is spent. It is also able to generate its own profits through returns on its investments (including the loans it makes to companies). However, FINEP is not entirely autonomous. Although there is an aspiration to become more financially independent from government in the future, FINEP currently receives most of its budget from the Secretariat of State for Science, Technology and Higher Education (SETI). This budget is set annually, which makes it difficult to engage in longer-term planning.



INSTITUTIONAL NETWORK

FINEP sits at the intersection of government, academia and industry, delivering its programmes in partnership with actors including the national science funding agency, regional development banks, and the powerful BNDES bank.



ORGANISATIONAL DESIGN

FINEP has an extremely hierarchical structure, with many different teams and units sitting under three strategic directorates (Innovation, Strategic Projects and Scientific Development), and two corporate directorates.⁸¹ The innovation and strategy directorates lead on different areas of industrial or sectoral support while the scientific development directorate provides support for university infrastructure. FINEP has regional offices in São Paulo and Brasília, and a few cooperation agreements (although no overseas offices) with research institutes and innovation agencies in Europe.



SKILLS AND EXPERTISE

FINEP staff have a mix of backgrounds, including economists, engineers, lawyers, and individuals with experience of working in the private sector or the civil service. Those with graduate or post-graduate level degrees (representing just under 90 per cent of the workforce) enter FINEP at 'Analyst' level, while those with secondary or college level education join as 'Technical Assistants'. FINEP provides support to staff interested in doing Masters or PhD degrees, and recently launched an internal 'FINEP university'. This makes training available to all staff on a range of issues, including innovation policy, economic or industrial affairs, intellectual property, and FINEP evaluation procedures. At present these courses are fairly general, but there is an ambition to make them more tailored to the needs of different people or teams within the organisation, and to open them up to external partners including companies and the civil service.⁸²



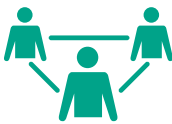
METHODS

APPROACH

FINEP supports all stages of the scientific, technological and innovation process, from research to commercialisation. To do this, it uses a range of (primarily financial) support instruments. Organisations receiving FINEP’s support are generally required to provide match-funding, whether through capital or in-kind contributions (such as access to laboratories or salary contributions).

BENEFICIARIES

FINEP works with research organisations and companies of all types and sizes, although the emphasis has shifted over time, depending on the priorities of FINEP’s management. For example, under the presidency of Glauco Arbix (2011-2015), there was a focus on supporting bigger businesses (whilst encouraging them to bring SMEs into their R&D initiatives). The current President, Luis Fernandes, is more interested in targeting support towards SMEs.

| TYPE OF SUPPORT | KEY PROGRAMMES |
|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Financial</p>  | <p>FINEP combines various financial instruments in most of its programmes. Refundable and non-refundable forms of support are available, including:</p> <ul style="list-style-type: none"> ★ Grants to public and private research institutes and universities. ★ R&D grants for companies. ★ Loans and credits for R&D and innovation projects in businesses (with negative interest rates and repayment periods of up to 12 years). ★ Equity, venture and seed capital to support creation and growth of high-tech companies. |
| <p>Support for intermediaries</p>  | <p>INOVAR: support for skills development within the VC industry⁸³</p> <p>InovaCred: decentralised loans operated by FINEP to public state or local banks (in charge of selecting projects) in order to support SMEs.⁸⁴</p> <p>National Program for Business Incubators and Technology Parks: support for the creation and consolidation of incubators and technology parks for innovative businesses.</p> |
| <p>Connecting and institution-building</p>  | <p>National Knowledge Platforms: structures that bring together industry and academia around a technological focus or problem, and support public procurement of technology and innovation.</p> <p>EMBRAPII: a network of thematic industrial research centres, funded jointly by the private and public sectors.</p> |

EVIDENCE OF IMPACT

FINEP has a number of internal tools to measure organisational performance, including the Executive Indicator Panel (which tracks indicators such as financial performance, new business development and company productivity) and the '30 Days' system, which provides data on the technological and credit rating of applicants to a project. The process also provides information on enterprise innovation activities and expenditures, and measures the total amount financed by FINEP. After two years of operation, FINEP is starting to use this information more strategically to review and improve its programmes. However, while FINEP analyses the results of individual projects, it has done less to evaluate programmes or the organisation as a whole.

FINEP has carried out a number of post-hoc programme evaluations showing a positive impact on company R&D investment.⁸⁵ A study of sectoral funds investment (FINEP's main instrument) shows a 1.5 increase in R&D for every R\$1 invested, with the greatest positive impact on very small and very large firms.⁸⁶ However, critics suggest that government spending supports R&D investments that would have taken place anyway.⁸⁷

- ★ **Inova Empresa** has been evaluated with 'robust' results to date, but has impacted less than one-third of companies that regularly invest in R&D.⁸⁸
- ★ The **INOVAR** programme has been described as a model for government efforts to stimulate a VC ecosystem.⁸⁹ As of 2012, the programme had cost around US\$13 million in operations but facilitated over US\$1 billion worth of investment in private equity funds.

INFLUENCE IN BRAZIL'S INNOVATION SYSTEM

As a large and well-resourced agency, FINEP has been an important player in the Brazilian innovation system for many decades. Its budget has increased eight-fold over the decade 2000-2010, alongside demand for its support.⁹⁰ It has only very recently started providing direct support to businesses, so it remains too early to conclusively determine the impact of these activities. However, the impact of its systemic interventions is well-documented, both in terms of the development of specific industries, and in other forms of business support (such as its Inovar programme, which increased the levels of venture capital for technology-based startup firms through public assistance and co-financing of technology-oriented VC funds).⁹¹

FINEP has had a more fluctuating role with respect to policy formulation. Although it is not formally tasked with strategic policy work, in practice it has helped the Brazilian government to develop new ways of increasing science and technology-focused R&D. For example, the Plano Inova Empresa and National Knowledge Platforms were both programmes that originated within FINEP, and were later scaled-up into major government initiatives. FINEP's political and policy influence is seen as depending heavily on politics, and the strength of the relationship between specific leaders within government and the agency.⁹² FINEP's president is a political appointee (nominated by the MCTI, approved by the Brazilian president) and can change rapidly following election results. Budgets are also set annually, which reduces FINEP's ability to set longer time-frames on its programmes.



Chile

CORFO

SUMMARY

The Economic Development Agency (CORFO) is Chile's national innovation funding agency, with beneficiaries that include individuals, entrepreneurs and businesses, other financial organisations and funds. CORFO's goal is to modernise the Chilean economy through efforts to both develop non-traditional sectors and increase the competitiveness of traditional sectors like mining.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|-------------------|------------------|------------------------|------|
| Santiago de Chile | 1939 | US\$345 million (2015) | 685 |

GOVERNANCE

National State agency sitting under the Ministry of Economy, Development and Tourism.

AIMS

To improve the competitiveness and productive diversification of the country by encouraging investment, innovation and entrepreneurship, strengthening in addition the human capital and capabilities to achieve a sustainable and territorially-balanced development.

COUNTRY PROFILE



GDP

US\$258.1 billion (2014)⁹³

GOVERNMENT SPENDING ON R&D

0.17 per cent of GDP (2014)⁹⁴

BUSINESS SPENDING ON R&D

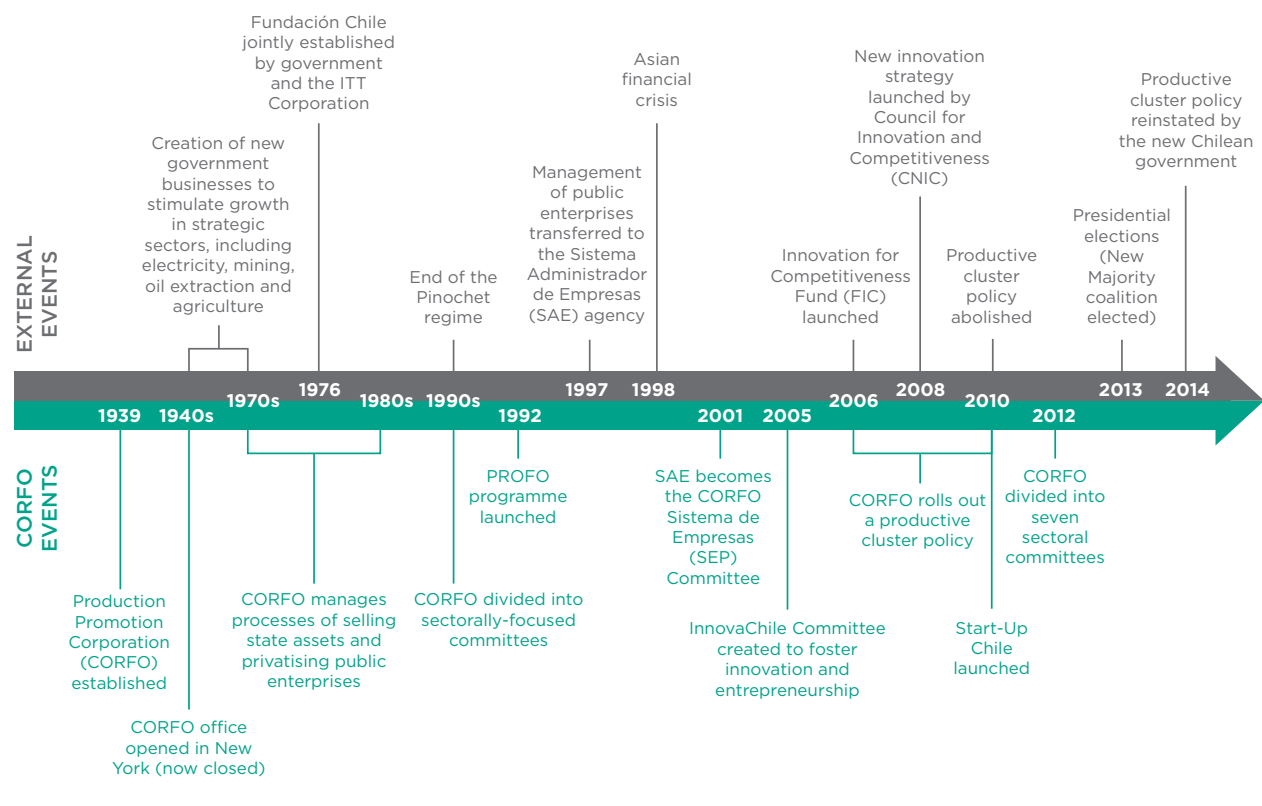
0.13 per cent of GDP (2014)⁹⁵

WHAT MAKES CORFO STAND OUT?

- ★ **Adaptive organisational model.** CORFO has undergone many institutional and directional changes since its establishment in 1939, reflecting the country's socio-political instability through the 1970s to the 90s. As a result, CORFO has developed the ability to quickly adapt to external events.
- ★ **Focus on developing new industries.** CORFO was created as Chile's development agency and has always taken a very sectoral approach, developing new strategic sectors and reinforcing traditional ones. More recently, this focus has been reflected nationally through the implementation of 'cluster' policies.
- ★ **A leader in its region.** Chile is one of the first Latin American countries to develop and implement entrepreneurship policies and support programmes. The Start-Up Chile programme exemplifies CORFO's leading regional role, having supported more than 400 entrepreneurs from 37 countries since its launch in 2010.

MISSION AND HISTORY

CORFO was created in 1939 following a devastating earthquake, with an initial mandate to improve Chile’s energy supply and establish a national steel industry. Since then it has undergone many transformations in response to political changes and crises. During the Pinochet regime, CORFO led a new movement of privatisation. After Pinochet stepped down as President in 1990, CORFO rapidly shifted its policy and focus towards greater economic development, promoting the competitiveness of Chilean companies in domestic and foreign markets, while supporting the development of small businesses. New goals were developed for the agency, including the promotion of business partnerships for competitiveness, the modernisation of management, the increase in financial support for early-stage businesses and the promotion of balanced development between regions. Today, CORFO is slowly shifting from more standard interventions and instruments to initiatives gaining in complexity, as knowledge and experience of processes is accumulated.⁹⁶



MANAGEMENT



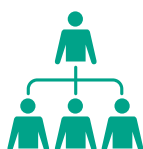
RELATIONSHIP WITH GOVERNMENT

CORFO sits under the Ministry of Economy, Development and Tourism, and receives funding from the Innovation for Competitiveness Fund (FIC). The Ministry of Economy and the National Innovation Council for Competitiveness (CNIC) set policy directions and interventions, while CORFO concentrates on the design and implementation of instruments and programmes. The agency outsources the delivery of many of their support programmes to Chilean public agencies, regional governments, industry associations or public and private research institutes. CORFO also manages the delivery of some regional innovation programmes, through their network of local offices.



INSTITUTIONAL NETWORK

CORFO's strategy has traditionally been to build a network of external partners instead of recruiting large numbers of staff.⁹⁷ One of these partners is CONICYT, the National Commission for Scientific and Technological Research, sitting under the Ministry of Education. The Ministry of Economy and the Ministry of Education have very different approaches and processes around common themes between CORFO and CONICYT, which has impeded coordination at the agency level.⁹⁸ Following a review by the Ministry of Economy on role overlaps, a few CORFO instruments for applied R&D were cut and transferred to CONICYT. CORFO also works with other grant-administering bodies in Chile. For example, in 2015 CLP1.9 billion (€2.5 million) was transferred from its budget to Fundación Chile (a non-profit corporation designed to support Chilean business and industry growth through technological innovation).⁹⁹



ORGANISATIONAL DESIGN

Since the 1990s, CORFO has been developing new areas of work through the establishment of internal committees. These committees arise from noticeable needs or gaps, and are closed down when they are no longer required. CORFO has a complex internal organisation currently made up of ten divisions: five in charge of staff and corporate services, and five that deliver thematically-focused entrepreneurship and growth support programmes. In 2014, CORFO reinstated a policy of clusters, defining seven strategic sectors: mining, tourism, agro-food, construction, the creative economy, agriculture and fishing, and advanced manufacturing.¹⁰⁰ Divisions are in charge of preparing roadmaps to plan work within these strategic clusters. Roadmaps and solutions or instruments to bridge the gaps in firm support are discussed during regular meetings and roundtables, with a focus on private sector participation.



SKILLS AND EXPERTISE

CORFO's employees come from a variety of backgrounds, including research, engineering and the private sector. However, its most senior employees tend to come from the civil service, reflecting the close relationship with government.



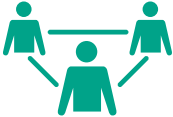
METHODS

APPROACH

CORFO’s programmes are mostly responsive and demand-driven, and always require co-financing from eligible beneficiaries. CORFO currently focuses its support within selected strategic sectors: mining, tourism, agro-food, construction, creative economy, agriculture and fishing, and advanced manufacturing.¹⁰¹ Support includes funding (predominantly grants, loans, credit lines, venture capital and seed-fund), technology and innovation capacity-building activities and network-building, and lasts on average for two to three years.

BENEFICIARIES

CORFO’s beneficiaries include micro, small and medium enterprises (MSMEs), entrepreneurs, students, financial institutions and stakeholders in specific industries. All types of firms are supported but there has been a focus on high-growth-potential SMEs in recent years (stimulated by the Asian financial crisis at the end of the 1990s, which revealed their vulnerabilities).

| TYPE OF SUPPORT | KEY PROGRAMMES |
|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Financial</p>  | <p>InnovaChile: increasing competitiveness and promoting an entrepreneurial culture and strategic investments in Chile.</p> <p>Concurso Go To Market:¹⁰² challenge-driven programme to help universities and companies move their ideas from development to commercialisation.</p> <p>Crédito CORFO Micro y Pequeña Empresa:¹⁰³ loans for SMEs to finance investment and support firm productivity.</p> |
| <p>Support for intermediaries</p>  | <p>Business Incubator Operation programme:¹⁰⁴ subsidises innovation and business incubators.</p> <p>Global Connection programme:¹⁰⁵ global network of service providers, through which scalable Chilean businesses and entrepreneurs apply for incubation.</p> <p>Networks of Angel Investors:¹⁰⁶ support for the creation of business angel networks.</p> <p>CORFO makes equity investments and opens long-term credit lines for risk capital fund managers to invest in R&D by SMEs.</p> |
| <p>Connecting and institution-building</p>  | <p>Attraction of Centres of International Excellence for Competitiveness programme:¹⁰⁷ centres to promote R&D in technology-driven, high impact-potential sectors.</p> <p>Start-Up Chile: 24-week-long seed accelerator programme, created to attract high-potential, early-stage Chilean and international entrepreneurs to set up their business in Chile.</p> |

EVIDENCE OF IMPACT

In-house monitoring and evaluation processes are relatively new to CORFO. An evaluation unit (currently five people) was set up internally in 2012, tasked with establishing more systematic evaluation systems. Before this, external consultants conducted programme evaluations on an ad-hoc basis. However, with the rise of the global economic crisis, greater attention has been paid to the way CORFO assigns its budget and there has been a push for more accountability and the development of useable organisational metrics.

Specific CORFO programmes have been evaluated by a number of organisations, including the University of Chile, the World Bank, the Inter-American Development Bank and the OECD, using methods like control and treatment groups to measure the effects of its support programmes. In general, programme evaluations have found that participation in the support programme led to improvements in short and medium-term outcomes, but results on longer-term impact were less clear.

- ★ Between 1991 and 2001, the investment programme **FONTEC** (which became **InnovaChile** in 2001) supported more than 1,700 innovation projects, valued at around US\$250 million, involving over 6,000 firms (around 85 per cent of which were SMEs).¹⁰⁸
- ★ The **PROFO** programme was launched in 1992 to promote R&D cooperation between groups of SMEs. While earlier studies indicated that the programme had had a positive impact on annual sales and salary increases, a 2011 study reporting on the 2002 to 2008 period found that although participants had a positive perception of the programme benefits, the impact was in reality small and limited to firms in the manufacturing sector.¹⁰⁹
- ★ Since its creation in 2010 (funded by CORFO), **Start-Up Chile** has received over 18,000 applications and has supported nearly 400 entrepreneurs from 37 countries. Graduating tech ventures have raised over US\$100 million.¹¹⁰

INFLUENCE IN CHILE'S INNOVATION SYSTEM

CORFO has played a changing role in Chile's economic development over many decades. In its early years it was directly involved in the development of new sectors, and used as a mechanism for nurturing state-owned businesses in a variety of industries, including electricity, telecommunications, fishing, sugar, and coal, among many others. After the turbulence of the Pinochet years, its position shifted to more of a funding and management role. It now funds successful agencies and programmes, like Fundación Chile and Start Up Chile, but does not do as much direct implementation work.

CORFO has played a relatively limited role in the development of government strategy. It has also had limited autonomy to develop and implement its own programmes. This likely stems from political scars and a fear of 'government overactivity' inherited from the Chilean government crises that began in the 1970s.¹¹¹ There is less overt political volatility currently, but government strategy with respect to innovation and business growth has also been subject to frequent changes, making it hard for CORFO to administer long-term plans and build up a strong organisational story of impact.



Finland

Tekes

SUMMARY

Tekes is the Finnish Funding Agency for Innovation. Steered and funded by the Ministry of Employment and Economy, it provides financing for R&D and innovation projects and works with innovative companies and research units across Finland.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|--------------|------------------|---------------------|------|
| Helsinki | 1983 | €550 million (2014) | 400 |

GOVERNANCE

Funding agency for technology and innovation, managed and funded by the Ministry of Employment and Economy (TEM).

AIMS

To promote the development of Finnish industry and services by means of technology and innovations.

COUNTRY PROFILE



GDP

US\$272.2 billion (2014)¹¹²

GOVERNMENT SPENDING ON R&D

0.3 per cent of GDP (2014)¹¹³

BUSINESS SPENDING ON R&D

2.29 per cent of GDP (2014)¹¹⁴

WHAT MAKES TEKES STAND OUT?

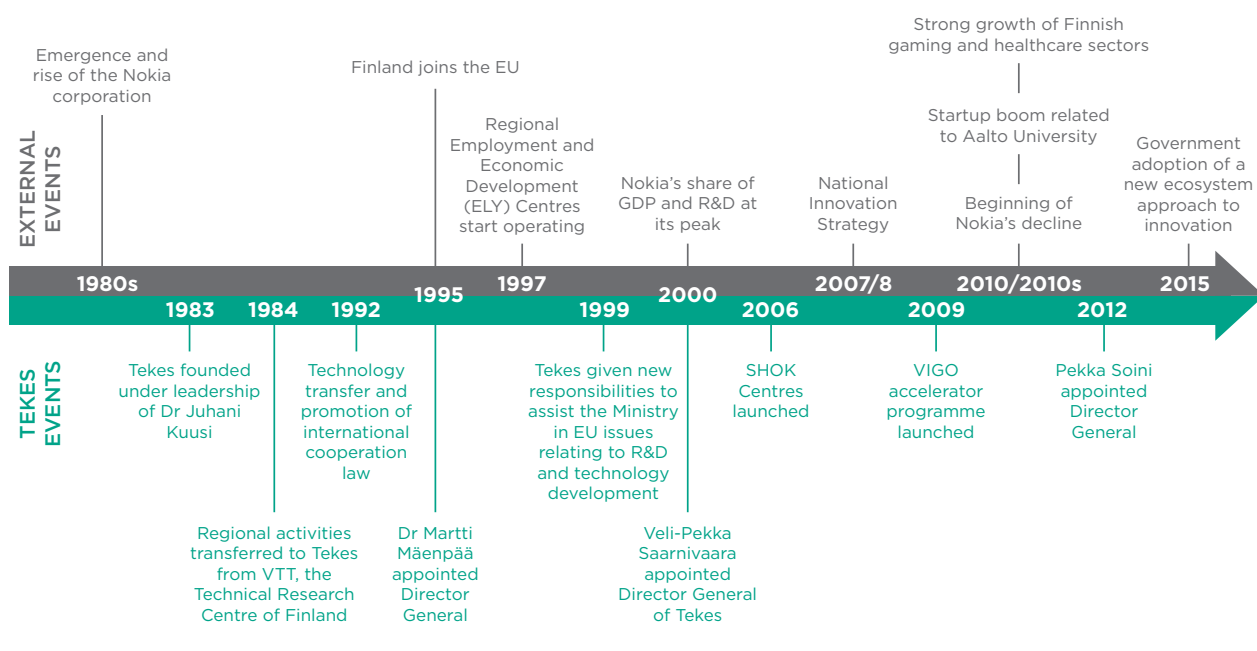
- ★ **High levels of institutional adaptability.** Tekes' initial mandate was to directly stimulate particular industries, with a focus on IT and telecoms. However, it has evolved substantially to take on a much broader coordination role in recent years, both in response to economic developments (notably the declining fortune of the Nokia corporation) and to business needs (through a practice of extensive consultation with industry).
- ★ **Experimentation with different types of innovation support instruments.** Tekes has experimented with both grant and loan funding for companies, manages a state-owned venture capital fund, facilitates government procurement of innovative products and services from SMEs, and is involved in the operation of a number of large public-private partnerships designed to generate the rapid development of innovations in strategically significant industries.
- ★ **Thorough monitoring and evaluation processes.** Projects supported by Tekes are evaluated at the outset when funding is applied for, when the project is finished, and three years after completion in order to identify any longer-term impacts. Tekes has also commissioned comprehensive external evaluations of the way the agency works as a whole, as well as the specific programmes it runs.

CASE STUDIES FINLAND: TEKES

MISSION AND HISTORY

Tekes was established in 1983 in response to the recommendations of a government-appointed Technology Committee of political decision-makers and expert representatives from government, the business community and academia. It was created to serve as the key planner and executor of a new technology-oriented policy approach, which aimed to rapidly develop Finland’s information technology sector as a way of stimulating industrial competitiveness. It built on Finland’s existing infrastructure, taking on responsibility for a range of activities that had previously been carried out by the Ministry of Trade and Industry, including R&D loans and grants and appropriations for technical research. Over the next few decades, its responsibilities expanded to include a more direct role in planning, funding and steering R&D projects (as opposed to simply allocating funds assigned by the government). Since the mid-1990s, it has also played a significant role in technology and innovation policy planning processes.¹¹⁵

Tekes’ mission has shifted from sectoral to systemic innovation and from technological to non-technological innovation. In the early 1980s, virtually all Tekes programmes were sectorally-focused, mostly linked to manufacturing and R&D-intensive technologies. The ICT sector became particularly dominant, driven by the rapid growth of the Nokia corporation in the 1980s and 1990s. However, this approach changed from the early 2000s on, as the Finnish government became more focused on customer-oriented, networked and open innovation systems. Currently, around 60 per cent of Tekes programmes relate to systemic open innovation issues, including ‘smart cities’, logistics and services.



MANAGEMENT



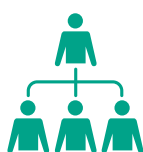
RELATIONSHIP WITH GOVERNMENT

Tekes is overseen by and funded through Finland's Ministry of Employment and Economy (which was created in 2008 following a merger of the Ministry of Trade and Industry, the Ministry of Employment, and some units of the Ministry of the Interior). Tekes has a close relationship with TEM, and there is a team based in the Ministry that interacts with Tekes very regularly. Given the cross-cutting nature of Tekes' work, the organisation also engages with a range of other government ministries. According to Petri Lehto at TEM, the Ministry gives Tekes guidance in the broad strategic areas it should cover, but then freedom to act within these guidelines.¹¹⁶ Tekes' external Board only decides on R&D project funding if the amount contributed by Tekes will exceed €3 million.



INSTITUTIONAL NETWORK

Tekes places a premium on its relationship with business. Tekes' Christopher Palmberg suggests that the organisation's 'guiding light' has been to respond to demand from industry, and to create a funding environment where broad thematic areas may be set, but that is then very open to competition and new ideas. Tekes also aims to involve industry partners in the development of the organisation's strategy, which is renewed every three years. According to Pirjo Kylakoski, Foresight Manager at Tekes, strategy is developed as an open process as far as possible, involving companies and others in the innovation environment as 'collaborators and authors'. Around 1,000 strategy discussions take place with companies every year.¹¹⁷



ORGANISATIONAL DESIGN

Tekes has grown rapidly as its portfolio has expanded, from 20 members of staff at the outset to more than 400 employees now working in Finland or abroad. The current organisational structure includes separate divisions that work with startups and SMEs, a team that focuses on 'networking businesses and research' and divisions that lead on strategic, corporate and business development activities.¹¹⁸ Tekes also has an internal research and foresight capacity, and invests €5 million a year to 'understand how the Finnish society and economy is renewing itself.'¹¹⁹ Tekes works both regionally (through the 90 members of staff based in local Centres for Economic Development, Transport and the Environment), and internationally, including through joint research projects and exchange programmes with VINNOVA and other innovation agencies. Tekes is also part of Team Finland, a network offering joined-up, state-funded services for companies looking to grow and internationalise.



SKILLS AND EXPERTISE

Over time, there has been an increasing emphasis on recruiting staff with experience of working in industry. The current Director General, Pekka Soini, has more than 20 years of experience working in senior management roles for Nokia Siemens. Currently, around half of Tekes' staff have a research background and around half have a business background, although it has been suggested that Tekes could benefit from developing more specialist expertise in certain areas. There is some business training for staff, although much of this comes from the 'on the job' experience of processing applications for funding.





METHODS

APPROACH

Tekes has experimented with a broad range of innovation support instruments, including grants and loans, equity investments, the facilitation of government procurement of innovative products from SMEs, and the management of large public-private partnerships to generate innovations in key industries. Almost 90 per cent of Tekes support goes to ‘high-risk’ R&D projects.¹²⁰ Around 40 per cent of Tekes funding is ‘reactive’, where companies can approach Tekes with an innovative idea or R&D project proposal that is not necessarily linked to specific thematic programmes. A further 20 per cent is dedicated to research carried out in the Strategic Centres for Science, Technology and Innovation (SHOK). Twenty-five per cent is spent on Tekes programme focus areas, and the final 15 per cent is reserved for other strategic priorities.¹²¹

BENEFICIARIES

Tekes funds companies, research organisations and public service providers. Over time there has been a shift towards supporting newer and smaller businesses. Larger companies are also eligible to receive funding, but usually have to provide a higher proportion of match funding.

| TYPE OF SUPPORT | | KEY PROGRAMMES |
|-------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial |  | <p>Young Innovative Companies: mixed grant and loan funding packages (of up to €1.25 million) for high-growth-potential young businesses.</p> <p>Development and piloting loans: low-interest loans to help companies test new products or services, production methods and business models.</p> <p>Tekes Venture Capital Ltd.: Tekes steers the management of this state-owned company, which invests in VC funds, which then invest in early-stage companies in Finland.</p> |
| Non-financial |  | <p>Horizon 2020 Preparation Programme: assistance with European funding bids for Finnish applicants.</p> |
| Support for intermediaries |  | <p>Vigo Accelerator programme: funding and support from successful entrepreneurs for high potential startups (scheme co-funded by Tekes).</p> |
| Connecting and institution-building |  | <p>SHOK Centres: six Strategic Centres for Science, Technology and Innovation that bring together research organisations and companies to conduct R&D projects in specific thematic areas.</p> <p>Finland Distinguished Professor Programme (FiDiPro): offers grants to global academics to engage in long-term research at Finnish academic institutions (scheme co-funded by Tekes).</p> <p>Global Market Access Program: funds MBA students from overseas universities (in the US, China and Singapore) to help Finnish businesses develop international growth plans.</p> |

EVIDENCE OF IMPACT

Tekes is one of the most comprehensively assessed innovation agencies. Most of this is done externally rather than in-house. For example the whole organisation was evaluated in 2012 by the Technopolis consulting group.¹²² Individual programmes are evaluated using a variety of econometric techniques and Tekes also assesses the impact of its main support methods and instruments.¹²³ Tekes-supported projects are evaluated regularly, at the outset when funding is applied for, when the project is finished and a few years after completion to identify longer-term impacts. As such, the organisation has built up a good bank of evidence on the impact of its activities, and can point to a number of clear success stories. For example, recent data suggest that:

- ★ For every euro invested by Tekes, companies increase their investment in R&D by two euros
- ★ Over 80 per cent of customers that have succeeded in their innovation activities report that Tekes funding has played a key role
- ★ Between 2010-2013, Tekes-funded SMEs saw job increases of 20 per cent more than other SMEs, and annual turnover growth of 24 per cent more than other SMEs.¹²⁴

Tekes' focus on impact measurement is driven in part by *“constant pressure from the media... that our taxpayer's money should generate turnover, employment and so on”*, although there is an awareness that the broader societal spillovers and impacts that the organisation aims to achieve are very hard to measure quantitatively.¹²⁵

INFLUENCE IN FINLAND'S INNOVATION SYSTEM

Finland has historically done well on comparative international rankings of innovation performance, sitting in the top five of several global indexes. Tekes' support for business is part of a broad set of public sector innovation interventions, alongside the activities of various government departments, Sitra (a public funding agency that reports directly to Parliament), and the Academy of Finland (an agency sitting under the Finnish Ministry of Education, Science and Culture that funds basic scientific research).

While this complicates efforts to draw out its specific contribution to Finland's overall innovation performance, it is clear that Tekes has been instrumental in facilitating the country's economic transformation into a producer and exporter of hi-tech products and services.¹²⁶ For instance, a longitudinal information database (known as SFINNO¹²⁷) has shown that 62 per cent of Finland's generally-known innovations have received funding from Tekes. In 83 per cent of these cases, Tekes support was considered significant for the inception and progress of the innovation process.¹²⁸ This database also shows that Tekes support has been particularly important in supporting totally new innovations (as opposed to those which make incremental improvements) and those which are more complex and take longer to reach market. Overall, Tekes beneficiaries report that support has made them increasingly willing to take risks and develop longer-term R&D strategies.¹²⁹



Israel

OCS

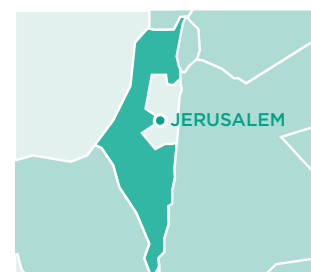
SUMMARY

The Office of the Chief Scientist (OCS) is the government agency in Israel responsible for executing policy relating to support for industrial research and development. The OCS spends around US\$450 million annually on nearly 50 programmes designed to make Israel a centre for high-tech entrepreneurship. It supports hundreds of projects a year, from early-stage, pre-seed development through to pre-competitive and long-term R&D projects.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|------------------------------------------------------------------------------------------------------------|------------------|------------------------|------|
| Jerusalem | 1974 | US\$450 million (2015) | 100 |
| GOVERNANCE | | | |
| Industrial agency of the Ministry of Economy, overseeing all Israeli Government-sponsored support for R&D. | | | |
| AIMS | | | |
| To ensure economic prosperity via technological innovation. | | | |

COUNTRY PROFILE



GDP

US\$304.2 billion (2014)¹³⁰

GOVERNMENT SPENDING ON R&D

0.52 per cent of GDP, excluding defence expenditure (2013)¹³¹

BUSINESS SPENDING ON R&D

3.49 per cent of GDP, excluding defence expenditure (2013)¹³²

WHAT MAKES OCS STAND OUT?

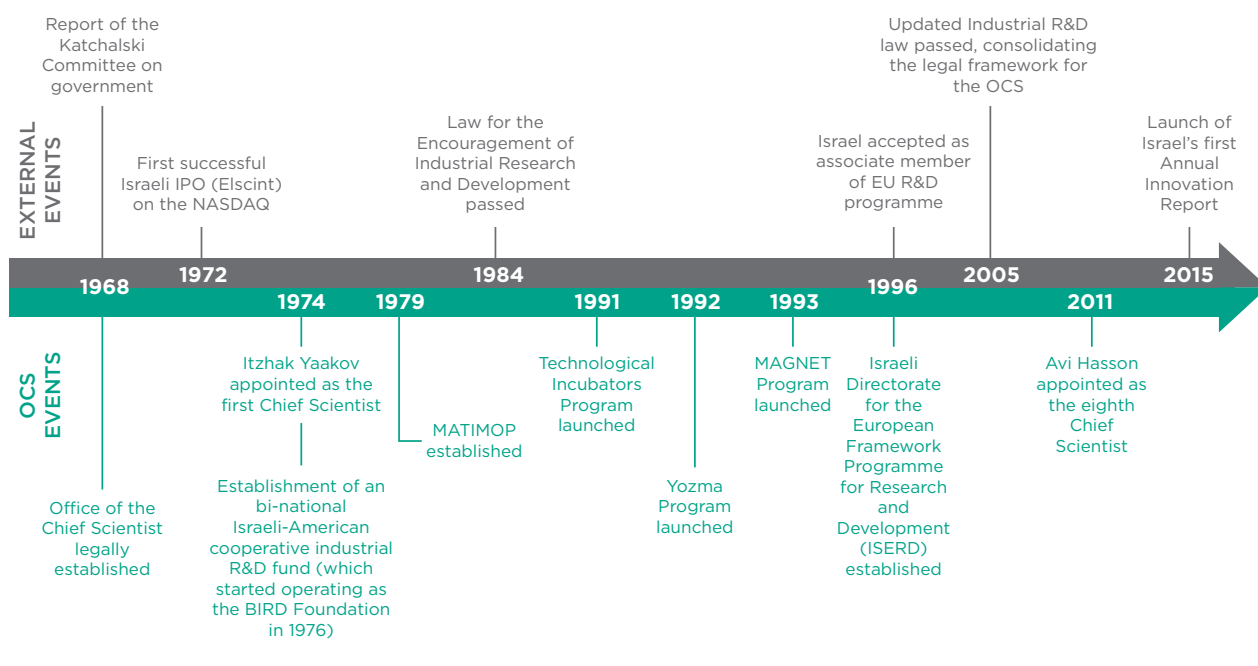
- ★ **Independence from government.** The OCS is accountable to the Ministry of the Economy but operates very autonomously. Its freedom to experiment and the successes that have resulted from this approach have enabled it to build 'high walls' between itself and the Ministry.¹³³ The OCS also has the ability to generate its own revenue through royalties on successful projects, complementing the budget allocated by the Ministry.
- ★ **A reactive approach to innovation support.** The OCS has traditionally been hands off in its approach to setting funding priorities. Until recently, the R&D Fund (the OCS's main funding instrument), acted as a 'horizontal' scheme, with no particular thematic priority, thus letting business priorities drive the development of new industrial niches.
- ★ **Conditionally-repayable grants.** The OCS's financial support primarily takes the form of conditionally repayable grants. It provides up to 50 per cent of project costs (or 66 per cent for startups), but only collects royalty fees from projects achieving commercial sustainability and defined levels of success.

MISSION AND HISTORY

The position of Chief Scientist was officially established in 1968, attached to what was then known as the Ministry of Commerce and Industry (now the Ministry of Economy). This was driven by the recommendations of an influential independent report on the management of government research that advocated creating Chief Scientist roles in every major Ministry, and by the need to generate more investment in private sector R&D.¹³⁴ However, it was not until 1974 that the OCS became an active state development agency.

In 1974, Itzhak Yaakov was appointed as the first Chief Scientist. He had previously held senior leadership roles in the Israeli military's R&D department, and was given a great deal of political and operational leeway to develop the organisation's strategy. Under his management, and with buy-in from political leaders, the main objective guiding the OCS's activities in its early years was to get businesses doing any kind of R&D at all. As such, the agency was not prescriptive about the type of innovation that firms pursued, as long as it resulted in the creation of new science-based products that could be exported.

These two principles - of neutrality on the part of the state with regard to the sector and technologies it supports, and a belief that private companies should be the main drivers of technological R&D - have continued to underpin the OCS' activities and strategy. Over time though, its general support for businesses across the economy has inevitably resulted in the development of some sectors or industrial niches more than others. The OCS has also created new programmes (including the Technological Incubators, Yozma and MAGNET initiatives) to provide more tightly-focused support than the general R&D Fund, either for different stages of R&D or for different types of beneficiary.



MANAGEMENT



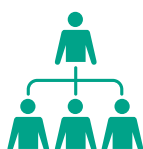
RELATIONSHIP WITH GOVERNMENT

Although the OCS is formally accountable to the Ministry of the Economy, it operates as a highly autonomous agency.¹³⁵ The OCS' funding model has also played a role in this. While it receives a large proportion of its budget via the Ministry of Economy, the organisation also generates its own revenue through royalties paid back from the successful projects that it supports. This money is then reinvested in the organisation's programmes. The proportion of revenue from royalties has increased over time - from 7 per cent of the OCS budget in 1988 to more than 30 per cent by the late 1990s. Within government, the Office of the Chief Scientist has a monopoly on setting strategy and delivering funding for applied business innovation. Wider governmental priorities are often taken into account by the OCS. For example, in 2013-14 the government set out a new target for Israel to reduce its dependency on oil, which subsequently fed into some of the OCS's grant funding streams. However, the government's innovation 'strategy' is very general, and the OCS does not receive much of a top-down steer. Its actions have therefore had a considerable impact on the development of the Israeli economy, especially during the 1980s and 90s.¹³⁶



INSTITUTIONAL NETWORK

Although it is very autonomous the OCS works in partnership with departments across government to deliver a number of specific thematic programmes. For example, the OCS is working with the Ministry of Science and Technology on a programme to develop new space technologies, and with the Ministry of Defense on programmes designed to develop new products and services with civilian and military applications.¹³⁷



ORGANISATIONAL DESIGN

The OCS has grown slowly but steadily over time, from a single position based within the Ministry of Economy to an institutionalised body of around 100 people managing a large number of programmes. The Research Committee, chaired by the Chief Scientist, makes decisions about which projects will receive support. While the committee is staffed by government officials and public representatives, a large number of external experts are brought in to review the applications. Following a lengthy review of its operations and programmes by an internal strategy team, the OCS is about to undertake a major reform process that will redefine the goals and structure of the organisation. The Office of the Chief Scientist is due to be replaced in 2016 by a National Authority for Technological Innovation, consisting of a set of innovation centres with different remits and target audiences.¹³⁸



SKILLS AND EXPERTISE

The background of OCS staff varies depending on level of seniority and their specific role within the organisation. Most of the team working on processing project applications and administering grants have a civil service background. However, senior members of staff usually have experience of working in industry. For example, the current Chief Scientist, Avi Hasson, previously worked for one of Israel's largest venture capital funds, and for a number of telecommunications companies. The OCS also leverages the expertise of a group of external 'examiners' who assess funding applications received by the agency. These individuals are experts in different fields relevant to the work of the OCS, and tend to have experience of working in academia, industry, or both.





METHODS

APPROACH

The OCS primarily takes a bottom-up approach to funding. Unlike many other innovation agencies, it is almost entirely driven by the priorities and needs of private companies, and the government has not historically been involved in setting thematic priorities for its funding calls. However, the OCS now runs a number of more specific funding calls for particular industries or linked to thematic challenges.

BENEFICIARIES

Private companies have consistently been the main beneficiaries of OCS programmes. The organisation gives grants to both large and small companies, but a larger proportion of its spending is on SMEs and startups. Financial support primarily takes the form of conditionally repayable grants: the agency provides up to 50 or 60 per cent of the project's costs (depending on the size of the company), with a royalty fee to be paid back only if the project achieves a certain level of success, although this varies between programmes.

| TYPE OF SUPPORT | KEY PROGRAMMES |
|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Financial</p>  | <p>R&D Fund: provides partial grant financing for innovative medium-term projects.¹³⁹</p> <p>Traditional Industries and KIDMA programmes: support innovation projects in specific industrial sectors, ranging from textiles and plastics to cyber security solutions.</p> |
| <p>Non-financial</p>  | <p>TNUFA: assists inventors and nascent startups on topics like filing for a patent, building a prototype, drafting a business plan and business development.</p> <p>Young Entrepreneurs scheme: training and incubation services for young entrepreneurs.</p> |
| <p>Support for intermediaries</p>  | <p>Technological Incubator Program:¹⁴⁰ underwrites lending made by incubators to transform innovative technological ideas in their early, high-risk stages into viable high-potential startups.</p> <p>Yozma Program: offers attractive tax incentives to inwards foreign VC investments.</p> |
| <p>Connecting and institution-building</p>  | <p>MAGNET Program: encourages industry and business-university collaborations by promoting technology transfer from academia to industry.</p> <p>Telem Forum: voluntary partnership between the OCS and other government bodies, aiming to establish a national infrastructure for R&D in common interest areas.</p> <p>Basic and Applied Nanotechnology Research Centres: building capabilities in the design and fabrication of nanodevices and strengthening the industry.</p> |

EVIDENCE OF IMPACT

Until recently, statistics and data on the OCS's programmes (and the organisation as a whole) were fairly patchy. External consultants conducted some specific programme evaluations, but monitoring and evaluation was not done in a systematic way. However, in 2011 an internal Strategy and Economic Research Unit was established to improve data on organisational impact. This small team uses various quantitative and qualitative techniques to assess programmes, including surveys, discontinuity analysis, regressions and client consultations. Although some of the longer standing OCS programmes have been running for many years (including the R&D Fund, Yozma and the Technological Incubator Program), it can still be difficult to assess their long-term impact because the goals and activities of these programmes often change over time.¹⁴¹

In 2008, the government commissioned an external evaluation designed to quantify the impact of government support to industrial R&D on the Israeli economy.¹⁴² The main findings of this study were that:

- ★ Government support for industrial R&D (the responsibility of the OCS) has increased the rate of private investment to 1.28 million, meaning that for every NIS 1 million invested by the government, industry has invested an additional NIS 1.28 million that it would not have otherwise.
- ★ Positive R&D spillover effects have been generated particularly for medium-sized and very large firms.

Other studies have suggested that government-funded R&D in Israel appears to be significantly more productive than privately-financed R&D, and that R&D subsidies granted by the OCS have succeeded in stimulating long-run, company-financed R&D expenditures.¹⁴³

INFLUENCE IN ISRAEL'S INNOVATION SYSTEM

The OCS has played a critical role in increasing the scale of industrial R&D in Israel. Through its investments and its ethos of supporting any kind of innovative activity, the OCS sent a clear signal to businesses that government would be supportive of R&D outside of the realm of basic research.¹⁴⁴ This, in turn, encouraged higher levels of private investment in industrial innovation, and higher levels of R&D activity within businesses. Between 1969 (just after the organisation's establishment) and 1987, industrial R&D expenditure grew at an annual rate of 14 per cent, while high-tech exports increased from US\$422 million to \$3,316 million (in 1987 dollars).¹⁴⁵

The 1990s are regarded as a particular high point in the OCS' influence, following the 1985 law that clarified their legal role and responsibilities. During this period, the cumulative impact of their ongoing grant funding and efforts to build an indigenous VC sector in Israel encouraged the rapid development of the high-tech sector, turning the country into a key player in global IT technology and producing a disproportionately high number of Israeli IT companies listed on the NASDAQ.

Throughout the 1980s and 1990s, the OCS filled a genuine gap in the provision of finance for industrial R&D. The need for their input has lessened as the Israeli VC industry has matured (although foreign investors provide a much larger share of investment in Israeli startups and established companies) and the OCS has seen a declining number of total and first time applications for funding since the mid-1990s. Its challenge going forward will be to develop a new strategy allowing it to catch up with current needs of the Israeli economy. This has been the focus of the recent strategic review and forthcoming organisational restructuring.



Sweden

VINNOVA

SUMMARY

VINNOVA is Sweden’s national innovation agency. It works to promote sustainable growth by improving the conditions for innovation and funding needs-driven research. VINNOVA works on facilitating collaboration between the private sector, the public sector and academia, encouraging greater use and transferability of research, building a strong research and innovation environment through long-term investments and increasing international cooperation in innovation.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|--------------|------------------|---------------------|------|
| Stockholm | 2001 | €355 million (2015) | 205 |

GOVERNANCE

Government agency working under the Ministry of Enterprise, Energy and Communications.

AIMS

To develop Sweden’s innovation capacity for sustainable growth and to benefit society.

COUNTRY PROFILE



GDP

US\$570.6 billion (2014)¹⁴⁶

GOVERNMENT SPENDING ON R&D

0.93 per cent of GDP (2013)¹⁴⁷

BUSINESS SPENDING ON R&D

2.28 per cent of GDP (2013)¹⁴⁸

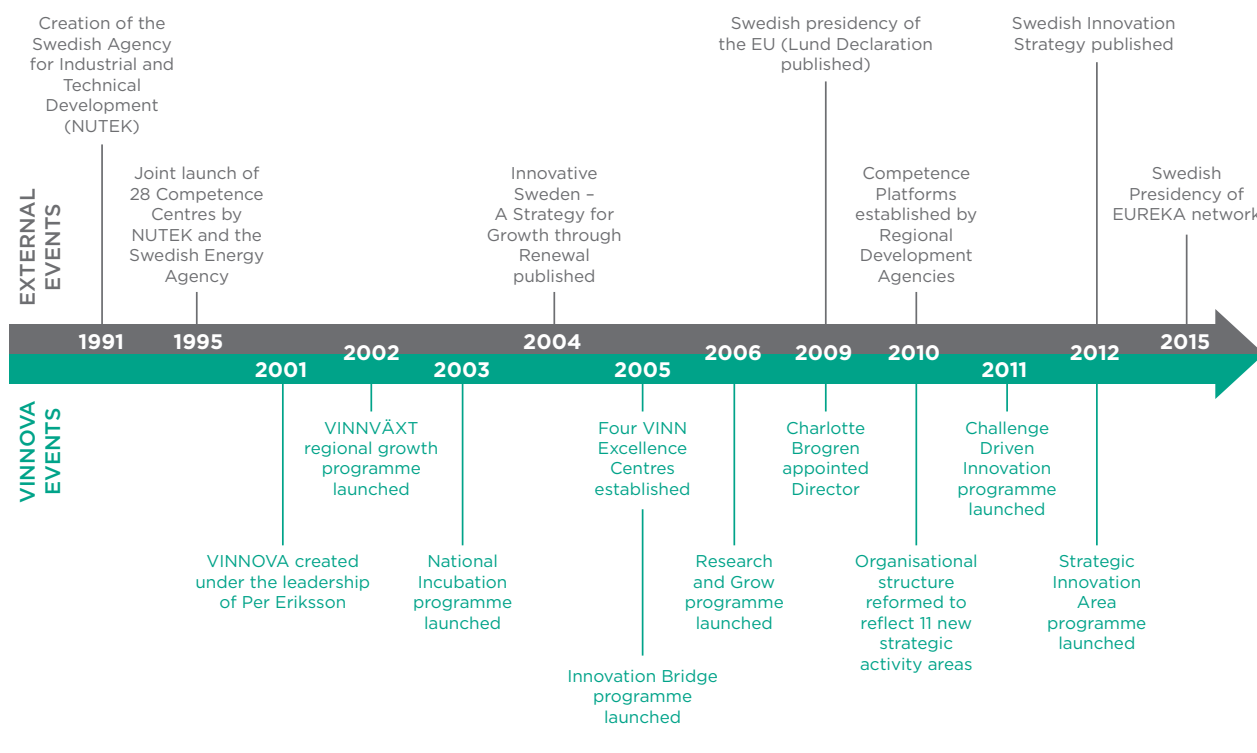
WHAT MAKES VINNOVA STAND OUT?

- ★ **Challenge-driven approach.** VINNOVA has led on developing the concept of ‘challenge-driven innovation’: an approach which funds technology projects that develop cross-sectoral responses to major societal challenges (such as in the areas of healthcare, education or climate change).
- ★ **Driven by industry priorities.** VINNOVA’s strategy is largely demand-driven. When developing new programmes, funding streams, or instruments, VINNOVA takes into account the roadmaps and innovation agendas collaboratively developed by relevant players in each industry, including research institutes, public and private sector actors and civil society.
- ★ **Cross-disciplinary ambitions.** VINNOVA’s work is highly collaborative. Although the organisation is structured under a set of distinct strategic themes, around 80 per cent of its funding aims to be cross-sectoral and cross-disciplinary.

MISSION AND HISTORY

VINNOVA was established in 2001 following a merger of three pre-existing agencies: the technology division of the Swedish Agency for Industrial and Technical Development (NUTEK), the Swedish Agency for Transport Research and part of the Agency for Work Organisation. It built particularly on the activities of NUTEK, but also took inspiration from Finland's Tekes in its design and in the types of programmes it set up. The primary purpose of this new organisation was to promote sustainable economic growth by financing needs-driven R&D and developing new innovation systems.

In the early years, VINNOVA focused on strengthening innovation cooperation between government, businesses and academia. This mission has not changed drastically over time, but VINNOVA has become more focused on increasing the public's capabilities to innovate, as well as putting users and customers at the centre of their work. There has also been a shift from individual industry sector-focused programmes, to cross-sector and actor initiatives linked to big challenges facing Sweden.



MANAGEMENT



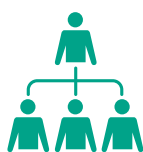
RELATIONSHIP WITH GOVERNMENT

VINNOVA has an arm's length relationship with its sponsoring Ministry of Enterprise, Energy and Communications. The organisation operates on a four-year budget (set out in the government's multi-annual Research and Innovation Bill, which VINNOVA feeds advice into) and designs its own programmes and targets, which are then presented to government. The government earmarks a certain amount of money for issues that it thinks the agency should work on (around 20 per cent of its budget currently), but these are *"brushstrokes rather than detailed instructions."*¹⁴⁹ It can, however, influence the focus of VINNOVA's attention at times, in response to specific events or challenges. For example, in 2008-2009, when the Swedish automotive industry was in crisis, VINNOVA was directed to use its programmes to encourage more R&D in this industry.¹⁵⁰



INSTITUTIONAL NETWORK

VINNOVA funds universities and other research institutes to improve their capacity to create new knowledge and networks that will be useful for industry and society. It also works closely with businesses and has a strategy that is *"very driven by industry priorities."*¹⁵¹ Each industry brings together relevant players (including large and small companies, academic research institutes, the public sector and civil society) to develop a roadmap and a set of priorities. VINNOVA then makes decisions about which among these competing innovation agendas to support through its programmes, and the instruments that will be most appropriate to deliver them.



ORGANISATIONAL DESIGN

VINNOVA's organisational structure has been linked closely to the broad thematic priority areas it works in: currently health and healthcare, transportation, environment, services, ICT and manufacturing, and innovation management. Although it has separate divisions for each of these areas, the aim is for 80 per cent of its funding to be cross-sectoral and cross-disciplinary. VINNOVA does some in-house analytical work to help set its strategy, although primary responsibility for foresight and research sits with other Swedish policy institutions. This has created some challenges linking up external research on the state of the art and VINNOVA's programmes.¹⁵² VINNOVA does not have any local offices, but it does have an overseas presence in Brussels and Silicon Valley, and it is the primary agency responsible for helping Swedish businesses and others seeking European funding for R&D and bilateral research agreements in non-EU countries (particularly Brazil, China and India).¹⁵³



SKILLS AND EXPERTISE

When VINNOVA was set up, there was a strong focus on recruiting individuals with an academic or research background (including a substantial number of PhDs). The majority of VINNOVA's employees still come from academia or the public sector, but there has been an increased push in recent years to hire people with experience of working in industry: these now make up around 30 per cent of the agency's workforce. This includes the organisation's current CEO, Charlotte Brogren, who worked for ABB (a prominent electrical company) for 15 years before joining VINNOVA. This mirrors recent strategic shifts with the agency, and particularly its efforts to be more cross-sectoral and cross-disciplinary in its approach.





METHODS

APPROACH

Each year, VINNOVA invests in than 2,400 research and innovation projects, primarily in the form of grant funding (for which match funding must be raised). These grants are currently channelled through around 50 different programmes, although there are plans to decrease this number further to focus on a smaller number of larger and longer-term initiatives.¹⁵⁴

BENEFICIARIES

VINNOVA currently allocates the largest share of its support to academic institutions. In 2013, 44 per cent of VINNOVA’s funds were spent on universities, 28 per cent on private companies, and 15 per cent on research institutes.¹⁵⁵ Within its support for companies, there has been a shift in the past five years towards supporting smaller businesses, in recognition of the fact that it may be more impactful than granting money to large companies already investing in R&D. Nearly 60 per cent of VINNOVA’s funding for companies now goes to SMEs.¹⁵⁶

| TYPE OF SUPPORT | KEY PROGRAMMES |
|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Financial</p>  | <p>Challenge-driven innovation: 10 per cent of VINNOVA’s budget is spent on technology projects that develop cross-sectoral responses to major societal challenges.</p> <p>Innovation Checks: vouchers (of up to around €10,500) to support SMEs that need access to new knowledge or technologies to test out innovative ideas (this scheme is subcontracted by VINNOVA).</p> |
| <p>Non-financial</p>  | <p>EU Framework programme hub: provides information and support to Swedish actors seeking finance or partnerships from EU schemes.</p> <p>Access to coaching and mentoring is provided through some VINNOVA programmes, but is not a standalone service offered by the agency.</p> |
| <p>Support for intermediaries</p>  | <p>National Incubator Programme: network of incubators for high-potential, high-technology and research-based startups.</p> |
| <p>Connecting and institution-building</p>  | <p>Mobility for Growth: mobility scheme for experienced (PhD level) researchers, implemented by VINNOVA in partnership with universities and businesses worldwide.</p> <p>VINNVÄXT: funding for regions to develop competitive clusters (with up to around €1 million available per year for a period of ten years for winning regions).</p> <p>VINN Excellence Centres: institutions to promote collaboration between the private and public sectors, universities, and research institutes.</p> |

EVIDENCE OF IMPACT

VINNOVA is a leader in terms of its approach to monitoring and evaluation. It commissions external consultancy firms to conduct interim and final evaluations of its programmes,¹⁵⁷ and runs follow up studies on its investments (working on the assumption that economic and systemic impact is best measured about five to seven years after completion of a specific project). It has also started making a greater effort to understand the value of its support to the recipients of funding, and now conducts regular customer enquiry surveys which are used internally as monitoring tools (although not published externally). VINNOVA uses these evaluations to make decisions about which programmes should be dropped. For example, it has stopped funding a small number of its VINN Excellence Centres that were judged to be underperforming.

Since its establishment, VINNOVA has supported more than 2,400 projects across a wide range of industries, investing just under €300 million a year in a range of strategic initiatives. There are signs that these investments are having a positive impact. For example, VINNOVA received 60 per cent more applications to its programmes in 2014 than 2012,¹⁵⁸ suggesting an increased interest in Swedish businesses and researchers in doing innovative projects.

INFLUENCE IN SWEDEN'S INNOVATION SYSTEM

There are many different actors in the Swedish innovation support system, and VINNOVA often works in partnership with other organisations to co-deliver specific programmes. As such, it can be difficult to draw out its specific influence on Sweden's innovation performance, particularly since it does not have a formal set of organisational metrics or performance indicators. Nevertheless, the agency is widely regarded as an example of good practice with respect to the implementation and evaluation of innovation programmes. A 2012 OECD review highlighted its broad and ambitious agenda and its ability to be self-reflective and adaptive as two of its key strengths, although it also noted that its relatively small budget limited its ability to achieve some of its more ambitious strategic objectives.¹⁵⁹

Through an aggregation of its programme results, VINNOVA judges that it has had a significant impact on the Swedish innovation system through the role that it (and its predecessor organisations) has played in supporting the development of new competence fields, including in the microelectronics, transport and biotechnology sectors.¹⁶⁰ VINNOVA has also had international influence, developing the concept of challenge-driven innovation. During the Swedish presidency of the Council of the European Union in 2009, the Lund Declaration was approved, calling for European research and funding to focus on the 'grand challenges' facing the global community.¹⁶¹ Since 2011, VINNOVA has increasingly directed its programmes towards cross-sectoral activities designed to address big societal challenges (such as healthcare and sustainability), which has inspired the strategies of other innovation agencies, including Innovate UK and Tekes.



Switzerland

CTI

SUMMARY

The Commission for Technology and Innovation (CTI) is Switzerland's national innovation promotion agency, with a mandate to support applied research and development projects and encourage entrepreneurship and the growth of new Swiss businesses. It invests resources in research-led innovation projects, and provides a range of consultancy services to startups and small businesses.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|------|
| Bern | 1943 | US\$165 million (2014) | 35 |
| GOVERNANCE Independent federal commission affiliated with the Federal Department of Economic Affairs, Education and Research (EAER). | | | |
| AIMS To help companies and individuals translate scientific research into successful business ideas for a strong Swiss economy. | | | |

COUNTRY PROFILE



GDP

US\$685.4 billion (2013)¹⁶²

GOVERNMENT SPENDING ON R&D

0.75 per cent of GDP (2012)¹⁶³

BUSINESS SPENDING ON R&D

2.05 per cent of GDP (2012)¹⁶⁴

WHAT MAKES THE CTI STAND OUT?

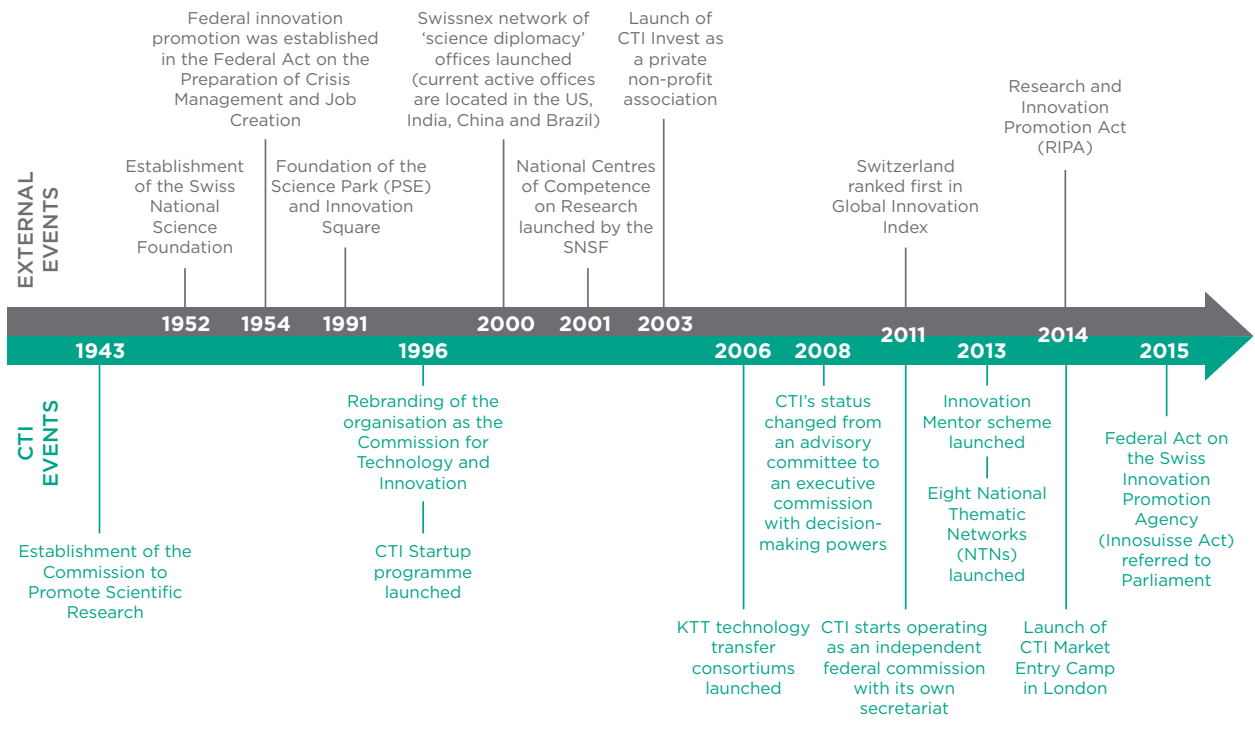
- ★ **A lean structure.** The CTI is a very small organisation in comparison to some of its international counterparts. Its core secretariat comprises 35 members of staff with generalist backgrounds, charged with programme management and delivery. Programme funding decisions are currently taken by an external panel of commissioned experts, appointed by the Federal Council.
- ★ **No direct financial support to businesses.** The CTI does not provide direct financial support to businesses working without research partners, because of a political view that private businesses should be funded privately. Most of the direct support it provides therefore takes the form of coaching and mentoring services.
- ★ **A focus on high-potential startups.** As part of its coaching programme, the CTI runs an accreditation scheme called the Start-up Label. It gives entrepreneurs that have been coached by the CTI the opportunity to apply for a certificate of excellence, helping them to gain recognition for the quality of their work and to make connections with potential investors.

CASE STUDIES SWITZERLAND: CTI

MISSION AND HISTORY

The Commission to Promote Scientific Research was established by the Swiss Federal Council in the early 1940s to help prevent the emergence of a post-war recession through the stimulation of science and technology-driven employment. Until 2006, this body (which was renamed the Commission for Technology and Innovation in 1996) was an extra-parliamentary advisory commission without any decision-making powers. However, following a revision of the Federal Constitution which specified that the Swiss Confederation would promote innovation in addition to scientific research, the CTI was made an Executive Commission. It became part of the decentralised Federal Administration at this point, and was given greater autonomy to make decisions in its areas of activity, although it has remained highly directed by government priorities.

The CTI’s mission today is to provide financing, professional advice and network-building services to support innovation projects that would not otherwise be possible due to market failures or lack of private funding. The focus is on research that has the potential to produce concrete and marketable products. In order to deliver more effectively on this mission, the organisation has successfully lobbied for a change in status to become an institution governed by public law. When this change takes place (currently set for 2016-2017), the CTI’s status will more closely resemble that of the Swiss National Science Foundation (Switzerland’s scientific research council), with the aim of increasing the impact of funding going towards commercialisation activities.



MANAGEMENT



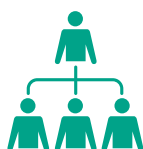
RELATIONSHIP WITH GOVERNMENT

At present, the CTI sits underneath the Federal Department of Economic Affairs, Education and Research (EAER), charged with implementing the ‘industry-focused’ side of its science and technology strategy. Its structure and status as an Executive Commission has made it more of a delivery organisation than a policy development and strategy-setting body. The CTI receives its financing via ‘block credits’ which are granted by the Federal Parliament for a period of four years. This multi-year budget is drawn up by the State Secretariat of Education, Research and Innovation (SERI) following consultation with all relevant parties (including the CTI), and then submitted to the Parliament to be revised (if necessary) and then passed. Broader economic conditions may affect this budget once it has been set though, in line with the Swiss practice of immediately cutting public budgets by a certain percentage if the economy is not performing as well as predicted.¹⁶⁵



INSTITUTIONAL NETWORK

Although the CTI’s overall strategy is largely directed by government priorities, its key institutional relationships are with the external Commission of experts that make decisions on project funding, and with the startups and small businesses it supports through its coaching schemes. It also cooperates closely with the Swiss science funding agency (SNSF), which provides different but complementary services. For example, the SNSF establishes National Research Programmes to fund discovery-oriented research in a variety of thematic areas; these often have a strong industrial or applied focus, and projects and funding streams are transferred to the CTI if there is clear evidence of commercial potential.¹⁶⁶



ORGANISATIONAL DESIGN

The CTI is smaller and more decentralised than many other national innovation agencies. Its Management Board consists of a President and six Vice-Presidents, each with responsibility for a different area of CTI funding. Alongside the Board is a Commission of external experts appointed by the Federal Council (of which there are currently 70), which makes decisions on the funding applications submitted to the CTI. A small secretariat (of around 35 members of staff) manages the administrative and delivery aspects of the main funding programmes run by the Commission. Organisational capacity is very much focused on the coaching and entrepreneurship programmes. This accounts for around 80 per cent of the Secretariat’s work, even though the Start Up and Entrepreneurship programme only represents 7 per cent of the CTI’s overall budget.¹⁶⁷ The CTI Secretariat also manages a network of regional coaches and trainers.



SKILLS AND EXPERTISE

The CTI’s Board and members of the Commission are experts in the thematic domains that the CTI covers, drawn primarily from academia and industry. The Commission has been described by the CTI as a ‘militia-style organisation’, in the sense that they provide their services and expertise to the CTI on a part-time basis, but do not represent particular pressure groups. This is seen as giving them considerable freedom to make independent decisions.¹⁶⁸ Secretariat staff tend to be generalists and programme managers rather than policy or technical experts, while CTI coaches are required to have a strong track record in business and management and an extensive network of business contacts in Switzerland and abroad.¹⁶⁹





METHODS

APPROACH

Around 90 per cent of the CTI's budget is spent on research-led partnerships with SMEs that aim to develop science-based innovations within seven thematic domains: life sciences, medical technology, knowledge and technology transfer, engineering, enabling science, energy research, startups and entrepreneurship. These domains are broad and determined largely from the bottom-up. The CTI targets its support towards applicants operating primarily in Switzerland, focusing on science-based innovations and with projects likely to generate innovations with multidisciplinary applications.

BENEFICIARIES

Historically, the CTI has not provided direct support to businesses working without a research partner. As of 2016, the CTI's only mechanisms for directly funding businesses are its mentoring and entrepreneurship coaching schemes, and the networking platforms it supports to help bring together innovative startups and investors.

| TYPE OF SUPPORT | | KEY PROGRAMMES |
|-------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial |  | <p>R&D Funding programme: grants to academic or other research institutions working with companies on applied R&D projects across a range of domains (the CTI typically provides grants of between CHF 1-2 million and match funding must be found).</p> <p>Innovation Cheques: financial support for Swiss SMEs partnering with Swiss research institutes to develop new ideas.</p> |
| Non-financial |  | <p>CTI Entrepreneurship scheme: courses for young entrepreneurs to help them develop ideas and take the first steps towards setting up a company.</p> <p>Startup Coaching programme: individually-tailored support packages for high-growth potential businesses.</p> <p>Innovation Mentor Scheme: brokers connections between Swiss companies, research organisations and experienced entrepreneurs.</p> |
| Support for intermediaries |  | <p>Business Angel Platforms: funding for business or trade associations willing to increase the number of business angels in Switzerland.</p> <p>CTI Invest: CTI part-funds this non-profit public-private network of investors helping innovative Swiss startups to find early-stage financing from business angels and others.</p> |
| Connecting and institution-building |  | <p>Knowledge and Technology Transfer (KTT) Support: builds networks between entrepreneurs and investors in Switzerland, providing partial funding for specific networking events and mapping innovation activities and funding opportunities.</p> <p>Swiss Competence Centres for Energy Research (SCCERs): CTI funds and co-manages (with the SNSF) academic research networks producing technology and innovation roadmaps and conducting applied research to develop solutions to a range of different energy-related social and technological challenges.</p> |

EVIDENCE OF IMPACT

The CTI does not have a regular process to evaluate the performance of the organisation as a whole, although it underwent a significant external review in 2002, and has been developing new impact assessment measures since 2011. However, data from its annual activity reports do suggest that the CTI's current programmes are having a positive impact on levels of business R&D and the performance of Swiss startups:

- ★ Federal funding for the main CTI R&D funding programme has increased over the past half-decade from just over CHF 100 million in 2010, to nearly CHF 120 million in 2014.¹⁷⁰ Application success rates have also increased.
- ★ The number of businesses admitted into the CTI's coaching programme has increased over the past few years (from 179 in 2013 to 218 in 2014) and there has been a small increase in the proportion of start-ups granted the CTI Label (from 40 to 42 per cent over the same time period).
- ★ In 2013, 77 per cent of the top 100 (and all of the top ten) companies in the Swiss Top 100 Startup Awards¹⁷¹ were CTI-coached startups.

The CTI also tracks the performance of startups through a database it funds (known as the Start Up Monitor).¹⁷² Through representative panel surveys, this database collates self-reported information about Swiss startups and the ecosystem they operate in, including data on: the background and leadership capabilities of startup founders; legal forms, shares, and investments; financial development and employment; the effects of startup labels; startup hotspots in Switzerland (cities, cantons, sectors); and the success factors of promotion activities and single agencies. The Start-up Monitor is still relatively new – it was created as an online platform in 2012 until being transformed into an independent foundation in mid-2015. Over time it aims to provide comprehensive data on the financing, performance and development of entrepreneurs and their startups in Switzerland.

INFLUENCE IN SWITZERLAND'S INNOVATION SYSTEM

In 2002, the CTI was evaluated (both internally and by peer review) to assess whether it was fulfilling its mandate and objectives.¹⁷³ The main conclusions of this exercise were that the CTI was helping Swiss businesses to improve their capacity to innovate, and that it was generally providing a well-coordinated package of business support initiatives. Areas for improvement were identified as being around developing more productive links with the SNSF – Switzerland's basic research promotion agency – and increasing the professionalisation of the CTI organisation as a whole. These are both issues that have been prioritised over the last decade. The CTI has established more 'bridge' projects with the SNSF during this time. It has also doubled the size of its Secretariat, and increased the capacity for supporting businesses through its various coaching and entrepreneurship schemes.

Switzerland consistently tops global innovation rankings. This is largely due to the country's strong focus on knowledge-intensive industries and scientific R&D; for example, in the 2015 Global Innovation Index it ranked first in PCT resident patent applications (per billion PPP\$ GDP).¹⁷⁴ Despite this stellar performance in terms of knowledge creation, the federal government prides itself on its 'lean' model of innovation support and sometimes claims to have no top-down innovation policy. This can complicate efforts to distinguish the specific role that organisations like the CTI are having in stimulating the development of science-based innovations. However, planned organisational changes and the shift to becoming a public institution will give the CTI more control over its budget and strategy, and therefore more pressure to demonstrate the results of its activities and overall economic impact.



TAIWAN

ITRI

SUMMARY

The Industrial Technology Research Institute (ITRI) is a non-profit R&D organisation that engages in applied technology research and technical services to develop Taiwan’s high-tech industries. It also provides more than 15,000 ‘industry services’ per year (including consultancy work, training, technology transfer activities, R&D collaboration and support for incubators).

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|--------------|------------------|------------------------|-------|
| Hsinchu | 1973 | US\$343 million (2015) | 5,650 |

GOVERNANCE

Non-profit R&D organisation, partly funded and administered by the Department of Industrial Technology (DOIT) of the Ministry of Economic Affairs (MOEA).

AIMS

To drive economic growth and help industries stay competitive and sustainable through ‘researching and developing industrial technology’, the results of which are then transferred to domestic industries.

COUNTRY PROFILE



GDP

US\$529.6 billion (2014 est.)¹⁷⁵

GOVERNMENT SPENDING ON R&D

0.4 per cent of GDP (2013)¹⁷⁶

BUSINESS SPENDING ON R&D

2.26 per cent of GDP (2013)¹⁷⁷

WHAT MAKES ITRI STAND OUT?

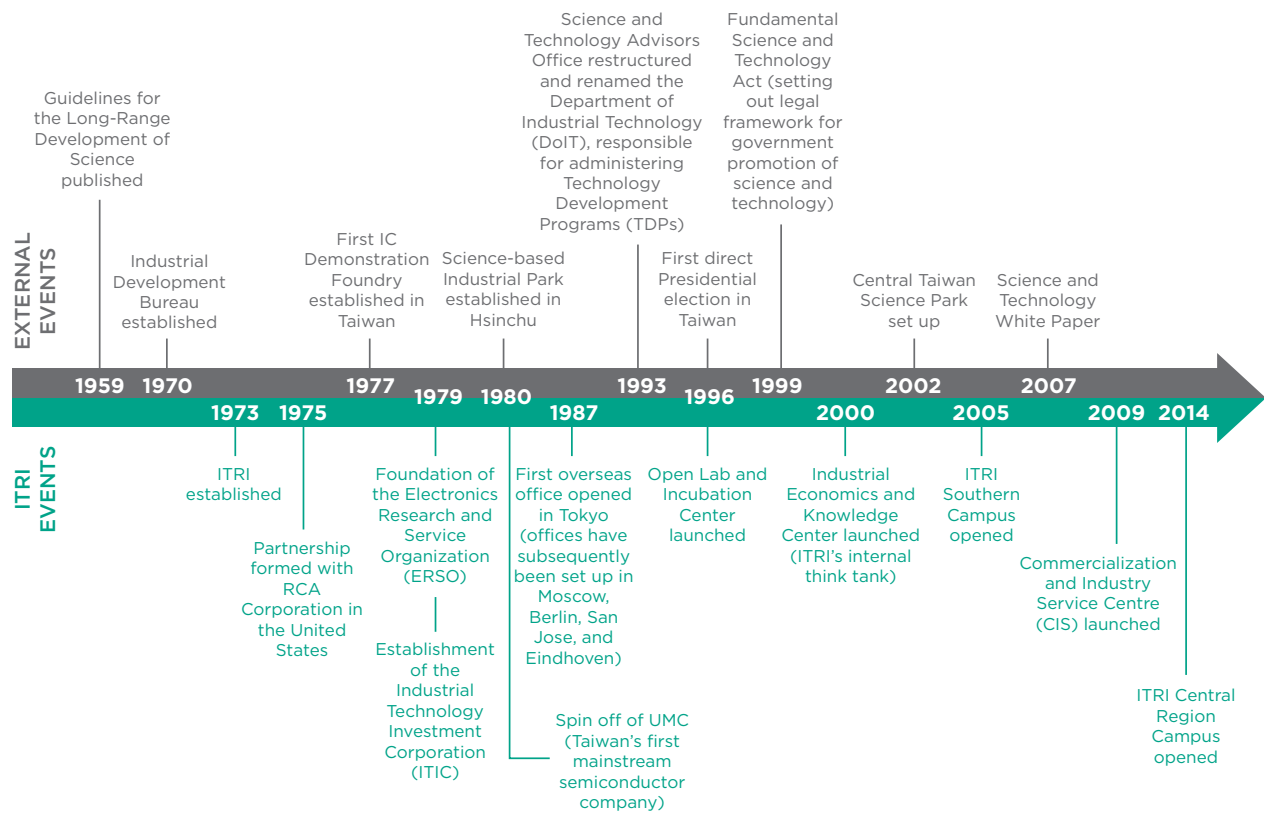
- ★ **Deep ecosystem integration.** ITRI has had a significant influence on the country’s economic development, leading research and investment in strategic industries. ITRI is also deeply intertwined with the Taiwanese business community, with many of the country’s SMEs having originated from ITRI projects.
- ★ **Internal R&D capabilities.** ITRI differs from other national innovation agencies in its remit and capacity to directly conduct applied technology R&D activities, and to create or incubate firms that are later spun-out to operate independently.
- ★ **Public and private funding model.** While ITRI’s budget allocation from government is directly linked to its annual performance, the organisation is also able to generate revenue from the services it provides to the private sector. This enables it to balance a results-driven agenda with the capacity to engage in riskier R&D projects.

CASE STUDIES TAIWAN: ITRI

MISSION AND HISTORY

ITRI was established in 1973 as part of a government strategy to rapidly move Taiwan’s economy from a reliance on labour-intensive production of consumer goods to a focus on technology-driven high-value industries.¹⁷⁸ The global oil crisis in the early 1970s acted as an additional impetus to facilitate Taiwan’s economic upgrading. ITRI was therefore created from a merger of three existing organisations – the Union Industrial Research Laboratories, Mining Research & Service Organization, and Metal Industrial Research Institute – and charged with helping to drive this economic transformation.

ITRI’s strategic evolution since then can broadly be divided into three phases. From the early 1970s until the mid-1990s, the focus was on technological development and production, aided by partnerships inside and outside Taiwan (particularly with the American RCA Corporation, which trained numerous ITRI employees and provided direct technological expertise with respect to integrated circuit technology). During this period, ITRI developed and spun out a number of companies which became the leaders in Taiwan’s semiconductor industry. A second phase started around 1995, involving training and technology transfer to domestic companies engaging in R&D, and the building of partnerships with international firms. Since the early 2000s, as Taiwan’s electronics and associated industries have matured, ITRI’s role has shifted more towards the commercialisation of business R&D, alongside continued applied research activities.



MANAGEMENT



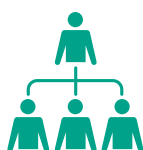
RELATIONSHIP WITH GOVERNMENT

ITRI is the largest of a number of science and technology research institutes that receive funding from the Taiwanese government. Half of its budget comes from the Ministry of Economic Affairs. The other half comes from the industrial services it offers to businesses. The government directly influences part of ITRI's research agenda. Government officials sit on the organisation's board, and more than 60 per cent of the funding it provides to ITRI is earmarked for specific programmes (although the targets that are set are jointly negotiated by ITRI and the government). However, ITRI is free to direct the rest of its budget to projects and programmes developed internally, giving it the flexibility to do more responsive work that is less tied to long-term government priorities.¹⁷⁹



INSTITUTIONAL NETWORK

ITRI has a particularly extensive and direct relationship with the private sector in Taiwan, resulting from its historical and current activities. Many companies in Taiwan's industrial parks are spin offs from ITRI, and around half of manufacturers have some kind of collaborative relationship with ITRI, either to conduct joint projects, or linked to technology transfer and services.¹⁸⁰ Since its establishment, ITRI has incubated or supported more than 260 companies, and been instrumental in the professional development of more than 140 CEOs of local high-tech businesses.



ORGANISATIONAL DESIGN

ITRI operates as a set of networked centres. Most of its staff are located in the headquarters campus, which is home to the Core Labs and research centres that develop new technologies, the ITRI College, ITRI's in-house think tank and the technology transfer office. ITRI has two other large campuses in different parts of the country, which aim to be both physically and intellectually close to local businesses. ITRI has built up a significant portfolio of international activities, encouraging inwards investment and R&D collaboration within Taiwan, and promoting Taiwanese technologies and companies abroad. There are five small ITRI offices in strategic areas: (Silicon Valley, Berlin, Eindhoven, Moscow, and Tokyo), developing long-term, two-way relationships between Taiwanese startups, researchers and international partners.



SKILLS AND EXPERTISE

Given its mandate to conduct applied research and development, ITRI's permanent members of staff are primarily recruited for their technical expertise. Most have an engineering background, and nearly a quarter hold PhD qualifications. This has increasingly applied to the top levels of management as well. While the first few presidents of ITRI came from a government or academic background, there has been a shift towards internal promotions to this role.¹⁸¹ For example, the current President, Jonq-Min Liu, joined ITRI in 1984 as an engineer in the Materials Research Laboratories, and subsequently rose through the organisational management structure.



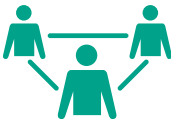
METHODS

APPROACH

ITRI is atypical compared to many other national innovation agencies in that it directly conducts technology R&D and helps to create or incubate companies that are then spun out to operate independently. Its primary focus is on creating new products, services or practical technologies with industrial applications, within a core set of thematic areas. Testing, piloting and prototyping work is conducted to help validate new technologies and minimise risks involved in market transfer. The other services it provides are described below.

BENEFICIARIES

ITRI does not provide grants or loans to businesses to engage in research and development. However, it does support technology transfer and business R&D in a number of other ways, including through incubation support, industrial and consultancy services. It works with companies of all sizes, but with a particular focus on startups.

| TYPE OF SUPPORT | KEY PROGRAMMES |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Non-financial</p>  | <p>Commercialization and Industry Service Center: consultancy and industrial services to companies to facilitate the commercialisation of new technologies.¹⁸²</p> <p>ITRI College: provides technology/management training and courses for government, academics and research institutes.¹⁸³</p> |
| <p>Support for intermediaries</p>  | <p>Industrial Technology Investment Corporation (ITIC): ITRI's venture capital subsidiary, which provides long-term capital to Taiwanese firms in strategic sectors.¹⁸⁴</p> <p>Open Lab: supports new companies working on specific projects with ITRI that would benefit from close cooperation or co-location.¹⁸⁵</p> <p>Incubation Center: provides consultancy services (for up to three years) to high-tech Taiwanese and international startups.</p> |
| <p>Connecting and institution-building</p>  | <p>Open Innovation Platforms: physical labs hosted by ITRI that facilitate university-business R&D collaboration.</p> <p>TechVenture Club: matchmaking services to create networks between companies, NGOs and VC funds.¹⁸⁶</p> <p>Joint academic R&D centres: currently seven centres based at six Taiwanese universities, focused on the development of future technologies.</p> |

EVIDENCE OF IMPACT

ITRI's status as a government-funded research organisation means that it undergoes an annual official external evaluation in which it is scored against a set of objectives, based on the review of reported results and statistics, case studies and site visits. It is measured against four main organisational performance indicators: its assigned tasks, the R&D results it produces (including the number of new patents and high-value IP transferred to industry); fiscal responsibility and revenue generation; and the industrial benefits of its activities (such as the number of spin-offs it creates). If ITRI achieves all of its objectives, it receives 90 per cent of its budget for the following year. The other 10 per cent is granted for 'exceptional performance', loosely defined, but particularly including evidence of successful technology transfer to industry, or help for companies to increase their international competitiveness in some way. With little scope for increasing ITRI's funding envelope, this financial model helps to focus decisions about which programmes are underperforming and should be dropped.

ITRI's focus on commercialisation leads it to measure its impact through quantitative outputs, including number of patents issued, number of companies spun off, income generated through industrial and research contract services or amount of induced investment through incubation. There is strong evidence to indicate the direct impact it has had on Taiwan's R&D performance:

- ★ ITRI holds more than 23,100 patents, and has been involved in the creation of 260 startups and spinoffs.
- ★ In 2014 alone, ITRI launched 14 startups in the fields of healthcare, system service and advanced materials and manufacturing.
- ★ Also in 2014, ITRI was responsible for 626 technology transfers to various businesses, and provided more than 15,000 consultancy services to industry.¹⁸⁷

INFLUENCE IN TAIWAN'S INNOVATION SYSTEM

ITRI has played a direct and impactful role in Taiwan's recent economic development. As a result of its research activities, Taiwan has become a world leader in the development and manufacture of semiconductors and associated hardware applications. The organisation is deeply entwined with the Taiwanese business community, with many of Taiwan's SMEs having originated in, or worked with, ITRI projects. It has played an 'environment-building' role, creating the conditions for industry to develop and engage in R&D.¹⁸⁸ ITRI has also benefitted from a close and cooperative relationship with government, and it is generally regarded as being one of the most, if not the most, influential government-funded research organisations. ITRI's senior management are extremely well-networked both within government and industry, which has created a situation where the organisation has essentially become "*too big to fail*".¹⁸⁹

ITRI's reputation and the central position it occupies within Taiwan's innovation system has created challenges as well as opportunities. As global economic conditions have worsened over the past decade, Taiwan's government has become more risk-averse. They are keen to see ITRI's work result in very successful projects, and have linked the maintenance of their annual budget to a very high rate of achievement. Yet this target-based approach may inhibit ITRI from conducting or supporting more experimental projects with unpredictable outcomes. ITRI has sought to address this problem by investing some of the revenue it generates from the private sector into riskier initiatives.



UNITED KINGDOM

Innovate UK

SUMMARY

Innovate UK is the UK's national innovation agency. Its purpose is to increase economic growth by supporting business-led innovation. It does this through programmes that bring together business, research and the public sector to accelerate the development of innovative products and services to meet market needs, and tackle major social challenges.

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|---------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|------|
| Swindon | 2007 | £615 million (2014/15) | 300 |
| GOVERNANCE | | | |
| Executive non-departmental public body, sponsored and funded by the Department for Business, Innovation and Skills (BIS). | | | |
| AIMS | | | |
| To accelerate economic growth by stimulating and supporting business-led innovation. | | | |

COUNTRY PROFILE



| |
|--------------------------------------------|
| GDP |
| US\$2,988.9 billion (2014) ¹⁹⁰ |
| GOVERNMENT SPENDING ON R&D |
| 0.12 per cent of GDP (2014) ¹⁹¹ |
| BUSINESS SPENDING ON R&D |
| 1.05 per cent of GDP (2014) ¹⁹² |

WHAT MAKES INNOVATE UK STAND OUT?

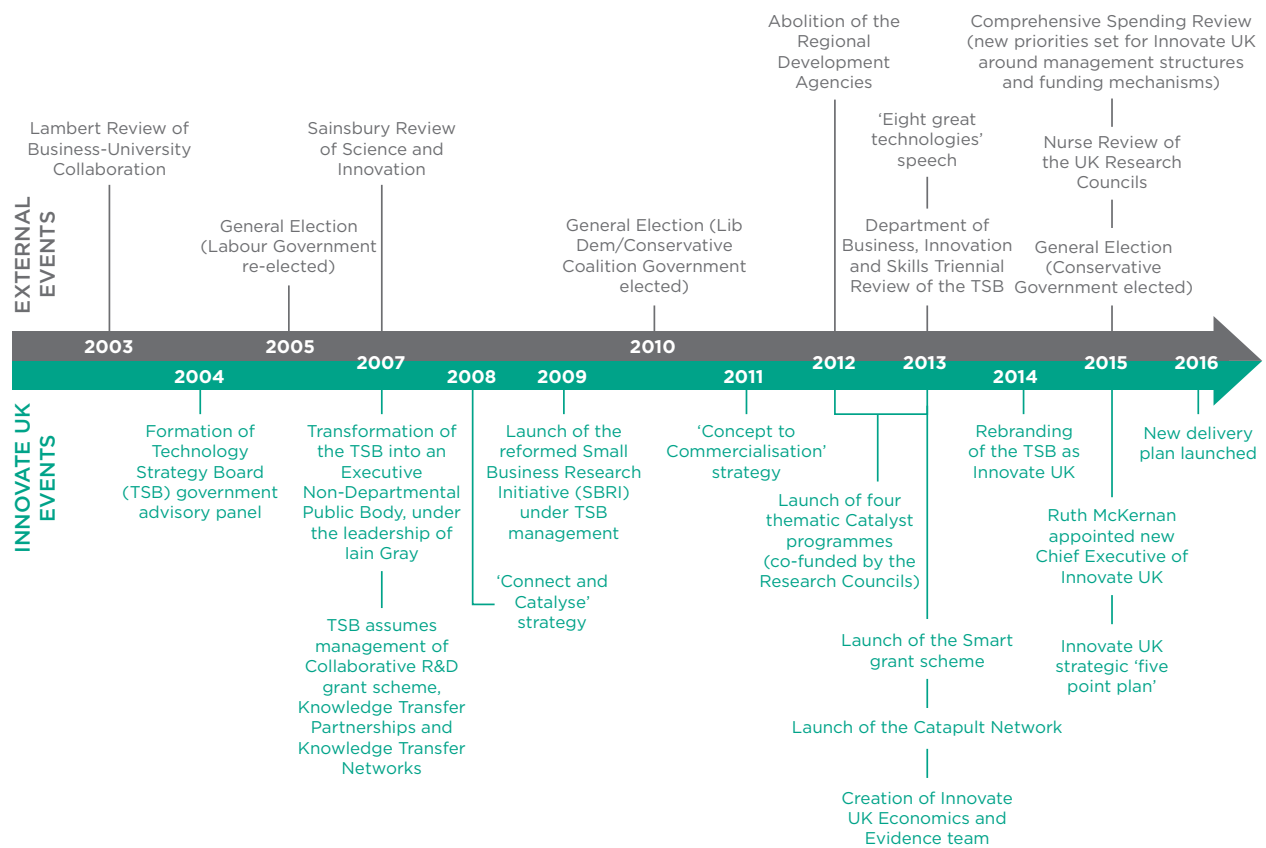
- ★ **Business-facing character.** In its aim to be a trusted partner for business, Innovate UK has deliberately recruited individuals with experience of working in industry or with technical expertise in its priority funding areas. This flows from the top down, with both of Innovate UK's Chief Executives to date having been recruited from an industry background rather than the civil service.
- ★ **Efforts to drive innovation within government.** Innovate UK has used its position to encourage more innovation within government procurement processes. Since 2007, it has helped more than 70 government bodies to run competitions to procure innovative solutions to public sector challenges, resulting in 2,000 contracts with a value of more than £270 million.
- ★ **Ambitions to better connect the UK's innovation system.** Ensuring the translation of scientific research into commercial success is the underlying goal of many of Innovate UK's flagship programmes, and there is quantitative evidence suggesting that these schemes are both generating economic value and making connections between researchers and industry that would not otherwise have existed.

CASE STUDIES UNITED KINGDOM: INNOVATE UK

MISSION AND HISTORY

Innovate UK began as an advisory panel of leading industrialists and civil servants (initially named the Technology Strategy Board), established in 2004 to make recommendations to government on priorities for a three to ten year technology strategy for the UK’s long-term economic development. It gained a reputation as an effective mechanism for transferring knowledge on emerging technologies between UK industries and universities, and was subsequently made an arm’s length executive agency in July 2007.

Since then it has grown in both size (from an organisation of 30 people to one of more than 300) and ambition. While it initially took on responsibility for a small number of existing programmes that had been managed by other bodies, its portfolio subsequently expanded to include small voucher schemes, major scaling-up programmes, multi-million pound demonstrator projects, institution-building initiatives and a programme of European and international activities. Its budget has also grown consistently. For the 2011-2015 period it was allocated just over £1 billion (resulting in £2.5 billion worth of investment when combined with funding from business, the UK’s Research Councils and other sources), with an additional £185 million allocated for 2015-2016 when Innovate UK took over responsibility for a number of funding programmes that had previously been managed by regional development bodies.



MANAGEMENT



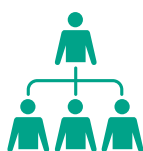
RELATIONSHIP WITH GOVERNMENT

As an executive non-departmental public body, Innovate UK's primary source of funds is grant-in-aid allocated by its sponsoring department (BIS), and it is ultimately accountable to Ministers for the way in which it delivers its strategy and spends its money. Innovate UK works closely with BIS at both the strategic and the operational levels, including through Ministerial meetings with Innovate UK's CEO and Chair, regular meetings between BIS and Innovate UK senior officials, and consultation processes on the development of Innovate UK strategies and delivery plans. Innovate UK also works with other government departments on a programme basis, particularly through the Small Business Research Initiative public procurement scheme. With UKTI, it runs annual themed overseas missions for selected UK businesses, and is involved in the management of joint R&D collaborative projects with a number of priority partners, including China, India and Brazil.



INSTITUTIONAL NETWORK

Innovate UK is highly business-facing. Its internal sector groups (formed from a recent restructuring of programme teams) make decisions about the broad thematic areas that Innovate UK will run funding competitions in, but only after extensive consultation with industry and other experts. Innovate UK also collaborates closely with the UK Research Councils, co-funding specific projects that aim to move scientific research into a commercialisation stage. In future, this relationship will be strengthened by an organisational integration of Innovate UK with these bodies.¹⁹³



ORGANISATIONAL DESIGN

Around three-quarters of Innovate UK's internal capacity is currently focused on strategy and programme delivery work, with the rest dedicated to operational functions, evaluation and business development. It does not currently have regional offices, although there are plans to establish a presence in Scotland and potentially other parts of the UK.¹⁹⁴ Innovate UK increasingly operates internationally as well as nationally. It opened a small office in Brussels in 2014, and it works with European and international partners through initiatives like Horizon 2020 and the TAFTIE innovation agency network.



SKILLS AND EXPERTISE

Innovate UK has deliberately recruited individuals with experience of working in business or who have specific technological expertise, rather than policy generalists seconded from the civil service. This cascades from the top down, with both of Innovate UK's Chief Executives to date having had long careers in business and industry. Innovate UK also has a small non-executive Board, made up of representatives of industry, academia and the civil service. Board Members are recruited openly, and their main function is to hold the Chief Executive accountable for decisions made about strategy, spending and personnel. While they have limited day-to-day involvement in the way the organisation's budget is spent, they are involved in decisions made about the annual portfolio.¹⁹⁵




METHODS

APPROACH

To date, Innovate UK’s support for business has primarily taken the form of non-repayable grant schemes that companies and other organisations bid into. Until recently, around two thirds of this spending was more open and responsive to need, with the rest being directed towards thematic challenge-driven areas. Following an organisational restructuring in 2016, Innovate UK has created four ‘sector groups’ that will channel funding to business innovation in key areas: emerging and enabling technologies; health and life sciences; infrastructure systems; and manufacturing and materials. Just over 85 per cent of its funding in 2016/17 will be spent on funding competitions in these areas. The rest will be spent on ‘open’ competitions that will offer funding for innovation in any sector.¹⁹⁶

BENEFICIARIES

Innovate UK funding is primarily spent on private sector R&D. In 2014/2015, 84 per cent of its grant funding went to private sector organisations, 14 per cent to universities and the not-for-profit private sector, and 2 per cent to public sector organisations. When Innovate UK was established, its main grantees were big businesses. However, SMEs and startups now receive about 60 per cent of the organisation’s support.

| TYPE OF SUPPORT | KEY PROGRAMMES |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Financial</p>  | <p>Following a consolidation of its distinct funding schemes, Innovate UK now has a single funding mechanism that allow businesses to bid for grants and pre-commercial contracts (and potentially other types of innovation financing in the future). A range of activities are supported, including: development and prototyping of new technologies and services; proof of concept and proof of market testing; the buying in of specific expertise to help businesses overcome specific challenges; and collaborative R&D projects between businesses and other research or public sector partners.</p> |
| <p>Non-financial</p>  | <p>Innovate UK offers access to coaching, mentoring, training and networking opportunities for the businesses it funds.</p> <p>Through its EU and International programmes, it also helps UK businesses to access funding through the Horizon 2020 programme and to build partnerships in other countries, including through offering UK businesses the opportunity to take part in overseas entrepreneur missions.</p> |
| <p>Connecting and institution-building</p>  | <p>Knowledge Transfer Partnerships: scheme to place recently qualified graduates in a business to conduct specific strategic projects.</p> <p>Catapult Centres: network of thematic centres designed to promote collaboration between UK businesses, scientists and engineers on solving technical challenges and joint late-stage R&D projects.</p> <p>Knowledge Transfer Network: teams working to connect sectors, disciplines and skills with the right collaborations and approaches in specific sectors.</p> <p>Innovation and Knowledge Centres: academic centres of excellence accelerating and promoting the exploitation of emerging research and technology fields, co-managed with the UK Research Councils.</p> |

EVIDENCE OF IMPACT

Over time, Innovate UK has sought to be more systematic in its approach to monitoring and evaluation. In 2013 it created a small internal team to bring the management of evaluation processes more in-house. Its initial activities have included surveying businesses for specific programme evaluations, and using other econometric methods to assess the organisation's portfolio. There is an ambition to evaluate Innovate UK as a whole in the future and to better understand the impact of its thematic interventions, although it has been difficult to develop a comprehensive set of key performance indicators and metrics.

Aggregated quantitative data from six of Innovate UK's major programmes suggests that Innovate UK's co-investments since 2007 have supported more than 7,500 businesses and are estimated to add £7.5 billion to the UK economy and create 55,000 extra new jobs. Other programme evaluations show evidence of positive economic or collaboration impacts that would not otherwise have been achieved.¹⁹⁷ The returns on many of Innovate UK's investments have been uneven. For example, 87 per cent of the benefits generated by the Collaborative R&D programme are thought to have come from just 5 cent of the projects it has supported.¹⁹⁸ However, the agency has consciously tried to take informed chances on areas and projects that look promising, but need support in order to develop, rather than investing in low-risk areas where there is a high probability of success.¹⁹⁹

INFLUENCE IN UK'S INNOVATION SYSTEM

Although Innovate UK is still a relatively new innovation agency, there are already signs that it is having a positive impact on the capacity of UK businesses to innovate. A 2013 review by BIS concluded that the agency was providing support to businesses in areas where the market offer was weak or non-existent and should be maintained as an independent body.²⁰⁰ Similar conclusions were reached by a House of Commons Science and Technology Committee investigation on improving the commercialisation of research in the UK, which recommended increasing Innovate UK's budget in order to meet demand from business.²⁰¹

Innovate UK is currently undergoing significant strategic shifts, both in terms of how it funds businesses and the way it works with the UK's scientific research funding infrastructure. Its approach to building on its existing achievements and continuing to provide effective support for business innovation while adapting to these changes will determine its influence in the UK innovation system in the years ahead.



United States

DARPA

SUMMARY

The Defense Advanced Research Projects Agency (DARPA) is an R&D funding agency that sits within the United States Department of Defense. With a budget of nearly US\$3 billion, its primary purpose is to invest in the development of new technologies that will enhance national security and give the US a globally-decisive strategic military advantage. DARPA does not have its own R&D facilities, but instead it supports the research of other organisations through technology challenges, research management, funding, thought leadership and other cultural and infrastructural support elements that help transition transformative ideas into reality.²⁰²

AGENCY PROFILE

| HEADQUARTERS | YEAR ESTABLISHED | BUDGET | SIZE |
|---------------------|------------------|-------------------------|------|
| Arlington, Virginia | 1958 | US\$2.87 billion (2016) | 240 |

GOVERNANCE

Agency of the U.S. Department of Defense

AIMS

To make pivotal investments in breakthrough technologies for national security.

COUNTRY PROFILE



GDP

US\$17.419 trillion (2014)²⁰³

GOVERNMENT SPENDING ON R&D

0.31 per cent of GDP (2013)²⁰⁴

BUSINESS SPENDING ON R&D

1.94 per cent of GDP (2013)²⁰⁵

WHAT MAKES DARPA STAND OUT?

- ★ **Risk-taking organisational culture.** DARPA's approach is marked by an extreme willingness to take calculated risks and a high tolerance of failure, as long as the potential breakthroughs generated by successful projects are significant enough. DARPA's processes also ensure that lessons are learned from failure, so that unsuccessful programmes and projects can have a potential impact on the development of new technologies.
- ★ **Finite programmes and employment postings.** All DARPA programmes are of finite duration to focus resources and intellectual effort and ensure delivery of outputs. DARPA's programme managers and office directors are employed on a two to five year fixed-term basis, giving staff strong incentives to deliver impact within their limited posting.
- ★ **Autonomy from government.** Despite being an agency of the US Department of Defence, DARPA has significant autonomy and independence to take risks in revolutionary research, and its budget is 'ring-fenced' with very little interference from Congress.

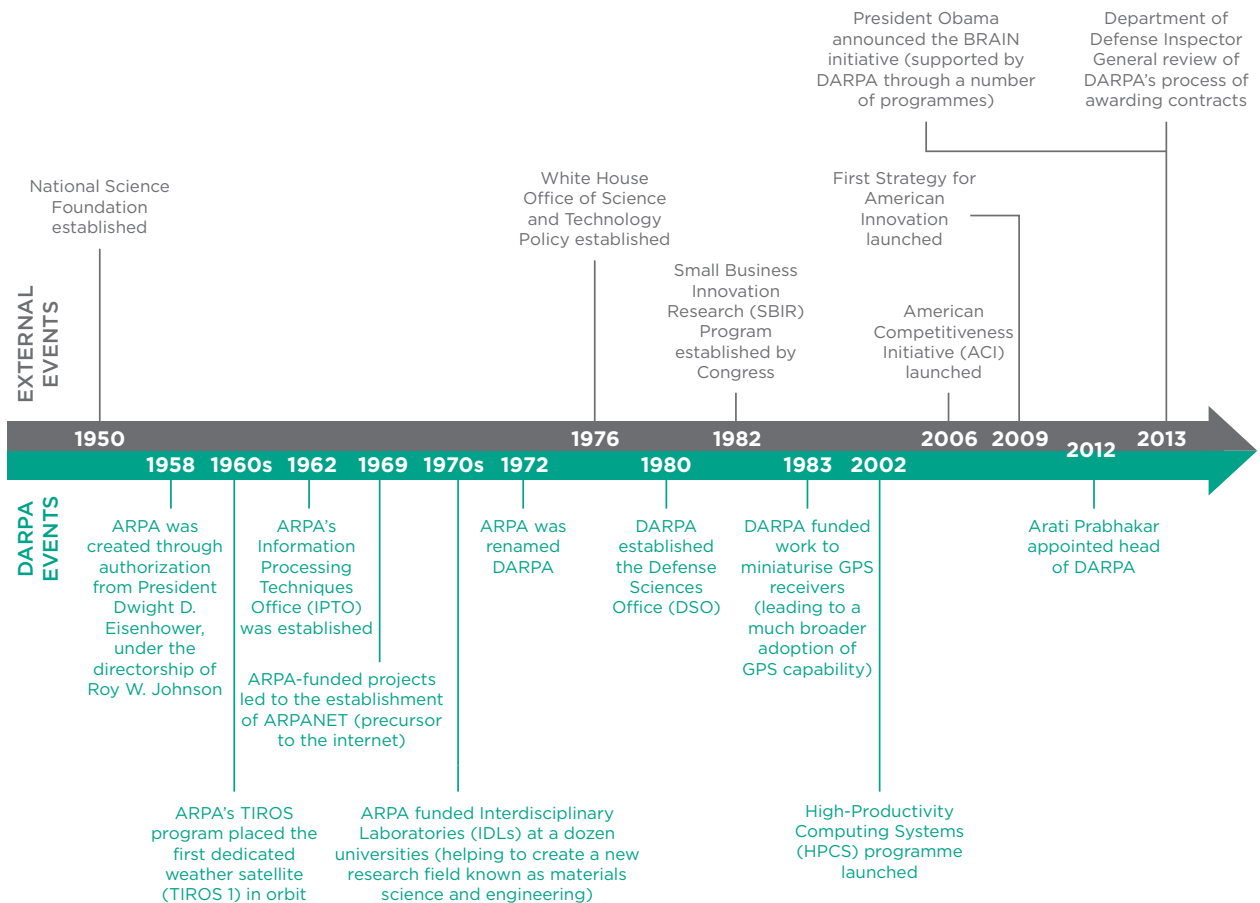
CASE STUDIES UNITED STATES: DARPA

MISSION AND HISTORY

Unlike many other innovation agencies, DARPA's primary mission – to maintain the technological superiority of the US military and invest in breakthrough technologies for national security – has held constant for more than half a century, even though the technologies it invests in have changed.

The agency was created in 1958 in response to the Soviet Union's launch of the world's first satellite in 1957, Sputnik 1. This technological surprise caught the US off-guard and pushed them to create DARPA, initially with the shorter name Advanced Research Projects Agency (ARPA). By setting up this agency, the US aimed to ensure that from that point forward, it would be the initiator and leader of revolutionary technologies.²⁰⁶

DARPA's initial focus was to conduct research on national strategic priorities such as space, nuclear and ballistic missile defence. After transferring this work to the individual military Service agencies (the Army, Navy and Airforce) and to NASA in the 1960s, the organisation opened up and started working across a much broader technological spectrum. During the 1970s and 1980s, DARPA (having been renamed in 1972) then focused on energy issues, information processing, tactical technologies and aircraft-related programmes.²⁰⁷ Currently, its main (broad) areas of thematic focus are the development of complex military systems, exploitation of the information revolution, biological technologies and expanding what is technologically possible in terms of physics and quantum engineering.



MANAGEMENT



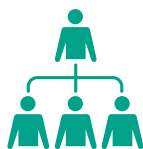
RELATIONSHIP WITH GOVERNMENT

DARPA reports directly to the U.S. Department of Defense (DoD)'s Assistant Secretary of Defence for Research and Engineering. Its annual (ring-fenced) budget is approximately US\$3 billion, which is around 25 per cent of the total DoD science and technology spend. DARPA's budget becomes law as part of the annual Defense Authorization Bill, but there is very little Congressional interference with the organisation's budget and programmes, and the agency has a significant degree of autonomy from other areas of the DoD. DARPA has special exemptions from many federal regulations and uses mechanisms such as contractor staff to ensure that they can react quickly and change priorities when required.



INSTITUTIONAL NETWORK

DARPA works within an innovation ecosystem that includes universities, industry, small businesses, and government partners. It is highly focused on the US military Services, which work with DARPA to create new strategic opportunities and novel tactical options.²⁰⁸ DARPA also works closely with partners across the DoD's Science and Technology community in order to accelerate the adoption of its technologies.²⁰⁹



ORGANISATIONAL DESIGN

DARPA has a flat and flexible organisational structure, operating at only two management levels to ensure a rapid flow of information and ideas and swift decision-making.²¹⁰ The agency is staffed by approximately 220 government employees in six technical offices, including around 100 programme managers, who together oversee about 250 research and development programs. The programme managers report to DARPA's office directors and their deputies, who are responsible for charting their offices' technical directions, hiring staff and overseeing programme delivery. Technical staff are also supported by experts in security, legal and contracting issues, finance, human resources and communications.



SKILLS AND EXPERTISE

DARPA is known for recruiting extremely high calibre programme managers for fixed-term appointments, drawn from academia, industry, government agencies, military and private laboratories. Multidisciplinary teams are created to deliver programmes. The agency looks for individuals with both technical expertise and programme management skills, and who can operate very autonomously. Programme managers are given the freedom to conduct high-risk, cutting-edge research. There is a strong sense of identity within the organisation and its historic reputation has enabled it to attract attracting very high quality applicants.




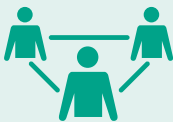
METHODS

APPROACH

DARPA does not own laboratories or research facilities, and all research is contracted to other organisations that are judged to be highly competent. DARPA’s focus is on funding potentially revolutionary research that bridges the gap between fundamental discoveries and ultimate military use. Therefore programme managers fund organisations to carry out research that might otherwise be too risky for research agencies to back. These managers have the freedom to enter new areas quickly, but also to pull funding if the research does not look like it will produce successful outcomes within an appropriate timeframe.

BENEFICIARIES

DARPA’s main beneficiary is the military, who utilise the technologies resulting from successful projects. However, the agency also aims for the results of its projects to find commercial applications, and so also works with universities, businesses and government agencies.

| TYPE OF SUPPORT | | KEY PROGRAMMES |
|-------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial |  | <p>Some of the main investment methods used by the organisation include:</p> <ul style="list-style-type: none"> ★ Prize Challenges: financial incentives to find solutions to urgent technological challenges ★ Small Business Innovation Research (SBIR) Program: provides opportunities for small businesses to participate in federal government-sponsored research and development ★ Calls for proposals: used by DARPA to award grants and cooperative agreements |
| Non-financial |  | <p>ENGAGE Program: enables the development of education and training systems that are better, faster, continuously optimised and scalable.</p> |
| Support for intermediaries |  | <p>Young Faculty Award (YFA) program: identifies and ‘matchmakes’ rising academic researchers with DoD/DARPA needs and programme development processes</p> <p>Service Chiefs Fellows Program: three-month fellowship programme involving outstanding military officers and government civilians</p> |
| Connecting and institution-building |  | <p>Proposers Days: conferences that provide information on recently released or soon-to-be released Broad Agency Announcements (BAAs)</p> |

EVIDENCE OF IMPACT

DARPA has 2,000 contracts, grants and other agreements with companies, universities, the DoD and other laboratories.²¹¹ The agency maintains a portfolio-level database that identifies outcomes by programme. However, the agency's process for tracking technology transition outcomes is not designed to capture transitions that occur after a programme completes and does not provide DARPA with an effective means for updating its database. As a result, the agency's database is unreliable for assessing transition rates and outcomes since 2010.²¹²

These measurement challenges aside, DARPA can tell a clear success story, with its funding having led to major developments across a range of military spheres. Over the past 50 years, DARPA's investments have produced globally transformative technologies with both military and civilian applications, including precision weapons, the Internet, automated voice recognition and language translation, and Global Positioning System receivers. Concurrently, the enabling technologies behind these military capabilities—new materials, navigation and timing devices, specialised microelectronics, advanced networking and artificial intelligence, among others – have helped lay a foundation for private-sector investments which create products and services that have changed how people live and work. Completing the loop, these technologies have subsequently been used by DARPA and other DoD agencies to respond to national security challenges.²¹³

INFLUENCE IN US' INNOVATION SYSTEM

Now in its sixth decade, DARPA remains at the forefront of efforts to maintain the United States' lead in military technology. Over this period it has been genuinely innovative in its approach, including by:

- ★ Investing in disruptive and high-risk technologies and ideas.
- ★ Opening up the defence establishment, and bringing new ideas to an otherwise often closed sector.
- ★ Creating both supply and demand for new innovations with a range of military and commercial applications.
- ★ Testing and proving the efficacy of new innovation support methods, such as challenge prizes.

Its successes over this period are unquestionably linked to the scale of its investments. With an annual budget of around US\$3 billion and access to a procurement budget of close to US\$600 billion, it can marshal resources that are well beyond the reach of most other countries. Without details of the projects that DARPA has supported that have failed, it is hard to get an accurate sense of its 'hit rate'. However, its pioneering methods and the breakthroughs they have led to have made it an innovation leader both within the US science and technology system, and globally.

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