

# **Governance of focused innovation policy to build resilience: Lessons for New Zealand**

**Working paper**

February 2024

Authors: Ron Crawford and Naomi Ashby-Ryan

NEW ZEALAND  
PRODUCTIVITY COMMISSION  
Te Kōmihana Whai Hua o Aotearoa



## The New Zealand Productivity Commission Te Kōmihana Whai Hua o Aotearoa

The New Zealand Productivity Commission (the Commission) is an independent Crown entity. The Commission completes in-depth inquiry reports on topics selected by the Government, carries out productivity-related research, and promotes understanding of productivity issues. We aim to provide insightful, well-informed, and accessible advice that leads to the best possible improvement in the wellbeing of New Zealanders. The New Zealand Productivity Commission Act 2010 guides and binds our work.

**How to cite this document:** Ron Crawford and Naomi Ashby-Ryan (2024) Governance of focused innovation policy to build resilience: Lessons for New Zealand, Working paper. Available from [www.productivity.govt.nz](http://www.productivity.govt.nz)

### ***Disclaimer***

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) and Longitudinal Business Database (LBD) which are carefully managed by Stats NZ. For more information about the IDI please visit <https://www.stats.govt.nz/integrated-data/>. The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes and is not related to the data's ability to support Inland Revenue's core operational requirements.

The contents of this report must not be construed as legal advice. The Commission does not accept any responsibility or liability for an action taken as a result of reading, or reliance placed because of having read any part, or all, of the information in this report. The Commission does not accept any responsibility or liability for any error, inadequacy, deficiency, flaw in or omission from this report. The opinions, findings, recommendations, and conclusions expressed in this report are those of the authors.

**Copyright:** This copyright work is licensed under the Creative Commons Attribution 4.0 International License. In essence, you are free to copy, distribute and adapt the work, if you attribute the source of the work to the New Zealand Productivity Commission (the Commission) and abide by the other license terms.

To view a copy of this license, visit [www.creativecommons.org/licenses/by/4.0/](http://www.creativecommons.org/licenses/by/4.0/). Please note that this license does not apply to any logos, emblems, and/or trademarks that may be placed on the Commission's website or publications. Those specific items may not be reused without express permission.

# Abstract

This paper describes the governance of focused innovation policy in five small advanced economies – Finland, Denmark, Sweden, the Netherlands and Singapore (with a further example from Canada). We look at how, and under what conditions, governance arrangements can provide a platform for building economic resilience and responding to unanticipated shocks. The paper looks at a variety of collaborative national and devolved governance arrangements. New Zealand generally lacks well-developed enduring arrangements for steering and implementing focused innovation policy, and can learn from the experience of other resilient and innovative small advanced economies.

# Contents

The New Zealand Productivity Commission Te Kōmihana Whai Hua o Aotearoa .....	2
<b>Abstract .....</b>	<b>3</b>
<b>Executive Summary.....</b>	<b>6</b>
<b>1 Governance of focused innovation policy to build resilience: Lessons for New Zealand .....</b>	<b>7</b>
1.1 Strengthening New Zealand's economic resilience.....	7
1.2 Innovation policy builds economic resilience.....	7
1.2.1 Focused innovation policy and resilience .....	8
1.3 Innovation ecosystems and governance of collaborative initiatives .....	9
1.3.1 Governance of focused innovation initiatives.....	9
1.4 Effective governance of focused innovation policy.....	10
1.4.1 High-level governance .....	10
1.4.2 Devolved governance .....	11
1.5 Focused innovation policy in selected small advanced economies .....	12
1.6 Governance in country-specific contexts .....	13
<b>2 Governance of focused innovation policy in small advanced economies.....</b>	<b>15</b>
2.1 Finland .....	15
2.1.1 High-level governance .....	16
2.1.2 Devolved governance .....	18
2.1.3 Assessment of governance arrangements .....	20
2.2 Denmark .....	21
2.2.1 High-level governance .....	21
2.2.2 Devolved governance .....	23
2.2.3 Assessment of governance arrangements .....	24
2.3 Sweden.....	25
2.3.1 High-level governance .....	26
2.3.2 Devolved governance .....	27
2.3.3 Assessment of governance arrangements .....	29
2.4 Netherlands .....	29
2.4.1 High-level governance .....	30
2.4.2 Devolved governance .....	31
2.4.3 Assessment of governance arrangements .....	32
2.5 Singapore .....	33
2.5.1 High-level governance of innovation policy.....	33
2.5.2 Devolved governance .....	34

2.5.3 Assessment of governance arrangements .....	36
2.6 Canadian global innovation clusters.....	37
2.6.1 Cluster selection.....	37
2.6.2 Devolved governance .....	38
2.6.2 Assessment of governance arrangements .....	40
<b>3 Lessons for New Zealand .....</b>	<b>41</b>
3.1 High-level governance.....	41
3.2 Devolved governance.....	41
<b>References.....</b>	<b>43</b>

# Executive Summary

Prosperous innovative societies are resilient to supply chain and other economic shocks because they have the resources and innovative capabilities to respond successfully to those shocks. Small, advanced economies tend to rate highly on measures of innovation and resilience and have high incomes and resources that enable them to adjust quickly to shocks.

The most successful small, advanced economies (such as Finland, Sweden, Denmark, the Netherlands and Singapore) use focused innovation policies to build their capabilities in selected parts of the economy or in selected technologies. Focused innovation policies build collaborative networks for innovation among firms, research organisations and government agencies. The purpose of such policies is various, including to improve productivity, increase exports, and to tackle issues that challenge sustainability, such as climate change mitigation and adaptation, adapting to new general-purpose technologies, and demographic changes like population ageing.

Devolved governance of focused innovation policies facilitates bottom-up solutions. Solutions are informed by networks of researchers and firms with intimate knowledge of technologies and of the means to apply them in commercial and societal applications. Devolved governance takes many forms across different countries and can serve a variety of purposes.

Evidence shows that devolved focused innovation programmes are successful in increasing collaboration among firms, researchers and government agencies, and lead to higher rates of innovation in products and processes. Yet, current experience suggests that such programmes are better at promoting incremental innovation, rather than transformative innovation to tackle broad societal challenges.

Well-governed devolved focused innovation programmes provided a platform, in some countries, for responding quickly to the supply chain shocks caused by the COVID-19 pandemic. This illustrated how such programmes can improve economic resilience to a range of unanticipated shocks.

Some small, advanced economies use high-level national governance arrangements to prioritise, steer and align public and private innovation effort. Others rely more on informal networks, a culture of collaboration, and devolved arrangements to do so across distinct but broadly defined areas of the economy. Designing focused innovation policies to tackle societal challenges is increasingly putting a premium on national prioritisation and steering of effort. Tackling such societal challenges requires aligning effort across many sectors of the economy and society. New Zealand, uniquely amongst small, advanced economies, currently lacks both effective high-level governance arrangements, and well-developed and well-governed networks for focused innovation policy.

Promoting focused innovation policy requires sustained effort over time, informed by evaluation of specific initiatives and periodic review of programme design and direction. Devolved governance arrangements take time to mature and produce a payoff in terms of successful innovation outcomes. Staying the course over many years is necessary for success.

# 1 Governance of focused innovation policy to build resilience: Lessons for New Zealand

## 1.1 Strengthening New Zealand's economic resilience

The 53<sup>rd</sup> Government directed the New Zealand Productivity Commission to investigate the policies and interventions that can enhance the resilience of Aotearoa New Zealand's economy to persistent supply chain disruptions. The scope of the inquiry focuses on medium-term, industry-level economic adaptation to persistent disruption. The Commission defines economic resilience as the capacity of industries and associated communities to anticipate, prepare for, absorb, recover from, and learn from supply chain disruptions.

New Zealand is especially vulnerable to supply chain disruptions because of its small size, distance from markets and from its concentration of exports in relatively few products and in a few large markets. It is also vulnerable to technological change that could render some of its primary export products less competitive in export markets.

This paper sets out the experience of selected small advanced economies (SAEs) in employing focused innovation policy to build economic resilience and achieve related societal objectives.

## 1.2 Innovation policy builds economic resilience

Over the longer term, modern societies prosper through innovation (Easterly, 2002). Businesses, communities, and societies continuously innovate to adapt to the opportunities and challenges they face. In turn, prosperous societies have the resources and capabilities to be resilient to economic shocks – they have fiscal reserves, good infrastructure, sound national and community institutions, and a well-educated, healthy population (Galt & Nees, 2022; Gluckman et al., 2023; Kaye-Blake, 2023; Martin & Sunley, 2020; The Treasury, 2021; S. C. Weber et al., 2023).

New Zealand enjoys many of these advantages of being a moderately prosperous society. Yet it faces challenges from lower productivity than in high-performing OECD countries, and relatively sluggish productivity growth. In our *Frontier firms* inquiry, we looked to the experience of the most successful small advanced economies (SAEs) for lessons on how to tackle these challenges. Compared to New Zealand, the most successful SAEs have outstanding records of exporting specialised and distinctive goods and services at scale, through the operation of firms operating at the global innovation and productivity frontier. Frontier firms are often large “anchor” firms working in collaboration with smaller specialised firms (NZPC, 2021).

In our *Frontier firms* inquiry, we found that successful innovation often requires co-investments across different firms, government and research organisations. Government contributes broadly through good institutions, and support for an educated healthy population that are a basis for prosperity. It also contributes directly through support for R&D, intellectual property regulation and governance and ownership of key research organisations (NZPC, 2021).

## 1.2.1 Focused innovation policy and resilience

Governments in successful SAEs often, as a complement to broad innovation policy, also deliberately focus policy and substantial resources on a small number of high-potential economic areas (Crawford, 2021; NZPC, 2021). In doing so, they recognise that small economies have only a limited number of areas that can get to critical mass and support sustained world-class competitive performance.

Economic success and prosperity have been primary motivations for SAEs to adopt focused innovation policies. More recently, such policies have been adapting to better tackle broader emerging societal, environmental and economic challenges (and opportunities), such as those arising from climate change, geopolitical rivalries and from technological change). Some SAEs have already recast or supplemented their focused innovation policy to tackle these challenges or have been urged to do so. For example, a recent evaluation of the Academy of Finland commented:

*The past decade in Finland has been a period of stagnation in both public and private R&D budgets and a loss of vision and systemic perspective at the level of recent governments. That loss is especially important today, when – with good reason – R&I policies are increasingly trying to address societal challenges. There is an urgent need at the national level not only to correct the policy failures of the last decade but also to reorientate policy towards these challenges. This is not only because some of the challenges pose existential threats to Finland and to humanity, but also because others' efforts to tackle them will lead to phasing out important economic activities, creating new markets and opportunities, from which Finland cannot afford to be excluded.*

Arnold et al. (2022, p. 126)

Focused innovation policy to achieve economic success builds resilience through increasing prosperity and so raising capabilities (including innovation capabilities) to respond to shocks. Increasingly SAEs are using focused innovation policies to tackle the challenges which are likely to be the source of future economic shocks.

Focused innovation policy requires collaboration across government, firms and industry organisations, and research organisations to identify priorities and set strategic directions and to implement programmes of innovation. Good governance creates a platform for identifying economic vulnerabilities and agreeing on actions to cover them off. The same relationships can also support a rapid collective response to unanticipated shocks.

The European Cluster Collaboration Platform, for example, identifies three functions of clusters (a form of focused innovation policy) in building resilience to supply chain challenges (European Cluster Collaboration Platform, 2021; Kamp et al., 2020) (Box 1).



### **Box 1 Role of economic clusters in anticipating and preparing for shocks**

Existing networks of firms and other government and non-government bodies can act together in a cluster to be more resilient to three types of supply chain shocks – those arising from political events, technology change and natural disasters.

Firms in clusters:

- can more readily find new suppliers, new markets and relevant research and technologies to address supply chain challenges (through *networking*).
- hold better collective *intelligence* on developments in markets, politics and technologies and are better able to share this intelligence.
- are better able to access *business support* for training, innovation and management of risks.

Source: European Cluster Collaboration Platform (2021).

## **1.3 Innovation ecosystems and governance of collaborative initiatives**

Innovation involves far more than developing new products or new production technologies. It includes changes in supply chains, distribution networks, marketing and markets, and the network of relationships among researchers, firms and other economic actors.

*Innovation is ...doing something new. An innovation may be a new or improved product, process, or function. Innovation is a process that leads to new or better ways of creating value for society, business and individuals. The value of innovation arises from [how an idea is used]. The value may be commercial, social or environmental. Innovation may be unplanned or even accidental ...*

Ministry of Business, Innovation & Employment (2019, p. 17)

Innovation is complex, cumulative, risky and path dependent. A wide range of factors directly or indirectly impact on innovation by firms – together these factors form an innovation ecosystem. An innovation ecosystem comprises many players, their capabilities, and the networks between them that together shape the rate and direction of innovation. The network of relations within and between firms, international links, research bodies, education and training providers, providers of capital, and the wider regulatory, tax and institutional framework are all relevant. Workers also move between firms, helping diffuse innovations as they go. Together these factors make up the environment that supports risk-taking along the often long and twisty path to implementing an innovation (Ridley, 2020).

The OECD contrasts innovation ecosystems with “business ecosystems, or (global) value chains, which foster innovation mainly through competition and are governed by the dominant firms that seek to appropriate the value of innovation by the participants...” (2022a, p. 71).

There is no clear boundary to define an innovation ecosystem: it will look different from the perspective of different players. For example, firms are likely to have stronger links to other firms in similar or complementary industries, especially those that are geographically proximate.

### **1.3.1 Governance of focused innovation initiatives**

Focused innovation policy requires collaborative governance arrangements that work with the grain of complex, cumulative and risky innovation processes. Firms, industry partners, researchers and government agencies need a voice in decision-making that reflects their investments of time, in-kind

resources and finance and funding. Given uncertainty around outcomes, and the complex path of innovation, governance needs to be open to changing membership. While setting priorities and the direction of effort, governance needs to adopt an experimental adaptive approach, building on effective monitoring, evaluation of specific initiatives, and periodic review of outcomes.

The scope of governance arrangements for focused innovation policy is a matter of choice. In practice the scope ranges from governance of specific innovation initiatives (for example, a programme to develop new technologies to reduce agricultural greenhouse gas emissions) to broad national agendas that aim to tackle societal challenges, and so encompass multiple complementary policy arenas.

Governance of specific initiatives may be nested within a broader agenda. Governance sometimes has a regional dimension (for instance, covering geographically concentrated technology clusters). Governance may have a strong sense of directionality (for example, to tackle societal challenges) or may, for instance, be designed to increase innovation generally within technology clusters.

Focused innovation policy is a process of discovering opportunities and tackling challenges to realising those opportunities (Rodrik, 2004). As a result, governments often choose relatively broad areas for attention and, with industry and other partners, design institutions, processes and funding arrangements from which the more promising opportunities can emerge.

In our *Frontier firms* inquiry, we recommended two levels of governance:

- a high-level national council to provide strategic leadership and broad coordination for focused innovation policy – including choice of focus areas and overseeing implementation
- independent governing bodies for each area of focus with devolved funding and decision rights – with significant long-term funding from both industry and government (NZPC, 2021).

## 1.4 Effective governance of focused innovation policy

### 1.4.1 High-level governance

National governance of focused innovation policy in a small economy, or more broadly of innovation effort to tackle societal challenges, necessarily involves prioritising among a wide range of possibilities and marshalling collective resources in pursuit of those possibilities over an extended period.

An emerging literature relates national governance of focused innovation policy to the demands of tackling societal challenges (Larrue, 2022; Schwaag Serger et al., 2015, 2023; Schwaag Serger & Palmberg, 2022; K. M. Weber & Rohrer, 2012).

Broadly high-level governance arrangements need the following features.

- A clear strategic direction, with high-level political and administrative support, and consensus among a wide group of stakeholders. The strategic direction needs to be flexible and able to adjust over time in a clear and transparent process. Yet it also needs to provide sufficient certainty around funding and policy over long-enough time horizons to give innovators the confidence to make the investments required for success.
- An effective means to align public investments and actions across different policy fields, and across different levels of governance (in federal systems, for instance). Investments and actions should deliberately take an experimental portfolio approach – allowing that some may not succeed.

- An effective means to devolve governance and draw in resources from private and public entities to undertake specific innovation programmes and initiatives.
- An ability through monitoring and evaluation of specific initiatives and of the collective outcomes, to adjust the mix of initiatives to drive the strategy forward.

High-level research and innovation councils are prevalent across the OECD, though not all have the features set out above (Borowiecki & Paunov, 2018; Paunov & Borowiecki, 2018). Only four (including New Zealand) of 31 OECD countries lack such a council (the others are Ireland, Italy and Norway) (Borowiecki & Paunov, 2018, p. 26). In 23 countries, national councils have a role in strategic priority setting. In nine countries the mandate extends to policy advice, policy evaluation and policy coordination (2018, p. 27). In 12 countries a combination of the Prime Minister, other ministers, and representatives from higher education, public research institutes and the private sector participate in their research and innovation councils (2018, p. 35).

## 1.4.2 Devolved governance

Section 1.3 describes the open and fluid way that innovation ecosystems develop in specific contexts and with a variety of purposes. In practice, participants may choose some form of collective governance to pursue a shared objective.

### The scope of governance arrangements can vary

The scope of collective governance can vary, for example, by geography (eg, a regional cluster of firms using related technologies), or by technology (eg, a focus on innovating in digital technologies across many firms in a country). The shared objective may also vary. Some arrangements may aim to build clusters of firms and researchers, to increase the general rate of innovation in promising technologies. Others may be more focused on identifying specific collaborative innovative programmes and projects to pursue chosen objectives over an extended period - such as raising productivity and improving export performance, or tackling challenges from climate change.

In our *Frontier firms* inquiry, we looked at focused innovation policies that could bring forth new products that would have a difficult-to-compete-away advantage in New Zealand's export markets. The Swedish strategic innovation programmes (SIPs) and the Canadian Innovation Supercluster Initiative (ISI) provided examples where control of substantial public and private resources to fund initiatives was devolved to enduring independent governing bodies set up for the purpose. Boards typically include representatives from businesses, industry organisations, and research organisations.

### Many forms of devolved governance exist

In practice, a wide variety of devolved governance arrangements for focused innovation policy exist across countries (Chapter 2 describes a selection). Many differ from those we recommended in our *Frontier firms* inquiry but may yet be relevant to innovation initiatives to tackle vulnerabilities and build resilience to future economic shocks.

The Danish clusters, for instance, are membership-based organisations – with boards comprising representatives from businesses, industry and research organisations. The government provides some time-limited funding for their operation. They aim to build up innovative activity in chosen areas of technology through information exchange, networking and events. Some include a regional as well as national focus.

Alternatively, government agencies may work through chosen large firms to implement initiatives, with funding conditional on those firms sub-contracting some of the effort to small firms and public research organisations. Business Finland has adopted this strategy over the last decade (Business Finland, 2022, n.d.b; Piirainen et al., 2019).

The New Zealand Centre for Climate Action Joint Venture is an example of an alternative goal-specific governance model, set up in 2022. Six large primary-industry companies are participating with the Government under the umbrella of the Centre for Climate Action on Agricultural Emissions to develop ‘on-the-farm’ solutions to reduce on-farm emissions. The board of the joint venture brings together senior leadership experience in the primary industries, research science and innovation, mātauranga Māori and government (NZPC, 2023). With a focus on reducing on-farm emissions, the scope of the innovation ecosystem is large – essentially involving changes in practice and technologies across many small farming businesses.

The City of Oulu, in northern Finland, adopted a mixed governance approach in response to the economic shock in 2010 arising from Nokia’s loss of market share to smart-phone companies, and dismissal of more than 2,000 high-tech engineers in the region. First it formed Business Oulu from existing agencies providing business services to promote new technology start-ups. Second it worked with the leading regional research universities and institutes to establish the Oulu Innovation Alliance (operating under the umbrella of Business Oulu). These new entities drew on existing networks (the University of Oulu had had a longstanding role in the development of Nokia) to successfully promote the development of a cluster of firms providing digital applications and services (BusinessOulu, n.d.; Kangas & Karonen, 2023). Nokia itself supported these developments locally and across Finland with its Bridge Programme that enabled former employees to participate in the creation of around 400 companies (OECD, 2022a).

## **Marrying bottom-up and top-down perspectives**

Devolved governance involving public agencies and resources needs to find a way to marry “top-down” perspectives on what matters for public policy, with bottom-up perspectives on opportunities for and challenges to successful innovation. Arrangements need to marshal resources for innovative effort, find ways to identify and tackle barriers, adapt to emerging circumstances, and put in place the means to monitor, evaluate and review progress. Parties that invest significant time and resources in pursuing innovation are only likely to do so if they have an effective role in shaping the direction of effort.

## **1.5 Focused innovation policy in selected small advanced economies**

This paper builds on and extends work for our *Frontier firms* inquiry on focused innovation policy in selected small advanced economies (Crawford, 2021). The countries – the Netherlands, Finland, Sweden, Denmark and Singapore – were chosen then for their similar scale to New Zealand and because recent reviews in English of their innovation policies were available for most of them.

Like New Zealand, these countries have necessarily been selective in where and how they have applied their innovation effort. Like New Zealand, they are relatively dependent on exporting to maintain economic performance. Each of these countries generally rates highly on international comparative measures of innovation. Recent work by the Credit Suisse Research Institute rates these European SAEs highly (in the top 10 of 32 countries) on an index of resilience that reflects a range of economic and social factors, including macroeconomic stability, labour market efficiency, social protection, country-level governance and innovation. New Zealand ranks in the middle at 19th (S. C. Weber et al., 2023).

This paper looks in greater depth at a limited number of countries, to better understand how governance of innovation policies works in practice, rather than extending the analysis to new examples. Even so, it also draws on examples from other jurisdictions (such as Canada) where they seem relevant to New Zealand.

This paper does not look at evidence for the success of focused innovation policy in terms of outcomes such as aggregate productivity performance, export performance and economic growth.

Each of the countries has high incomes, most rate highly on international measures of innovation, and most have highly successful large multinational exporting firms. Their recent productivity performance has been mixed, but usually superior to New Zealand's (NZPC, 2021, 2023).

Demonstrating a link between focused innovation policy and economic outcomes would be a complex exercise, given the wide variety of arrangements and the ways in which they have evolved over time. The countries in this study generally have a very strong culture of evaluating programmes and initiatives. They use evaluations to adjust course and revise the content and focus of initiatives to better achieve the desired outcomes. We note conclusions from some of these evaluations in our description of arrangements in specific countries.

## 1.6 Governance in country-specific contexts

A wide variety of high-level national and devolved governance arrangements for focused innovation policy exists. The variety reflects in part different country contexts shaped by history, political arrangements, culture and economic circumstances including economic structure. Observers need to take these contexts into account in drawing lessons for New Zealand.

Some northern European countries have a long and continuous history of industry policies associated with collaborative relationships between governments, business, worker organisations, universities and research institutions. Much of this is shaped around innovative manufacturing that has a large regional market in the form of the European Union. These conditions lend themselves to evolving governance arrangements that build on a well-developed culture of local (and international) collaboration for innovation purposes. History and culture can keep networks operating even when political and outside events bring disruption.

Comparator SAEs also often have large outward-facing firms around which local innovation ecosystems form. Denmark, for example, has well-established large firms in shipping (Maersk), pharma (Novo Nordisk), renewable energy (Vestas), brewing (Carlsberg), as well as Lego, Gundfos, and others. A similar story is true in Finland, Sweden, the Netherlands and Switzerland (Skilling, 2020).

In turn, some of these large research-intensive multinational companies build strong relationships with research universities, support networks of innovative technology companies, and establish research foundations that play a substantial role in supporting innovation. Novo Nordisk and the Novo Nordisk Foundation are examples for Denmark (Novo Nordisk, 2014; Novo Nordisk Foundation, 2020; NZPC, 2021). Nokia played a similar role in Finland, which has enabled the emergence of a new digital services industry after the shock of Nokia's loss of market share in mobile phones (Ali-Yrkkö et al., 2021; Kangas & Karonen, 2023; OECD, 2022a). Movement of skilled workers between firms strengthens informal networks while stimulating innovation through cross-fertilisation of ideas and experience.

Singapore's governance arrangements have been shaped by geography and its history since independence in the 1960s. Its rise as a high-income SAE was built on its position as a major port, a strong emphasis on education, and active state involvement in supporting economic development. Singapore is geographically concentrated and, though a multi-party democracy, has been governed by a single party throughout the period since independence. These factors have created strong and enduring networks across industry, government and the universities that help the formation of widely supported agendas for economic and social progress. Individuals often lead through successive roles in the elected government, government ministries, business, the universities and even the trade union movement.

Governance arrangements in each country are also influenced by the role and scope of government agencies, the relationships among them, whether there are separate innovation funding agencies and the political salience of innovation agendas. Some countries have an innovation council separate from a research council, each with different but possibly overlapping roles. The European Union's innovation policies influence those of its constituent members.

The complex interplay of all these influences means that governance arrangements are evolving over time. The way in which they are changing and why also provides lessons for New Zealand.

# 2 Governance of focused innovation policy in small advanced economies

## 2.1 Finland

Finland rated fourth on the European Union's innovation index in 2017 (after Switzerland, Denmark and Sweden) (Fagerberg & Hutschenreiter, 2020). It has for many decades had strong institutions and substantial government funding to foster collaborative research between public agencies and the private sector in technologically significant areas of the economy (such as forestry and forestry products, mobile communication and digital technologies) (Finnish Forest Cluster Research Strategy, 2010; OECD, 2017). Education policies complemented these developments with a highly educated and technologically literate workforce.

Finland's export strengths historically have mostly been in a combination of raw materials, production machinery and capital investment goods (eg, ships) and more recently in telecommunications. Private R&D is concentrated in a relatively few large companies. Such companies have been the main drivers of research links between business and higher education institutions.

*Finland's innovation ecosystems are often driven by large R&D-intensive firms like Nokia, Neste and Sandvik, as well as the multitude of innovative start-ups, highly innovative universities like Aalto university, research institutes for applied research like...VTT...public innovation funding agencies namely the Academy of Finland and Business Finland...venture capital investors that include public investment funds like Tesi<sup>1</sup> and Sitra, and Slush, the platform connecting start-ups and tech firms with investors.*

OECD (2022a, p. 71)

Among public research institutes, the largest, the Technical Research Centre of Finland (VTT), has played a significant role in industry-oriented research. VTT, in 2015, had a turnover of €251 million (NZ\$ 440 million) with external funding of €163 million (NZ\$ 287 million).

The 1990s and early 2000s saw the rapid growth and global market dominance (for a period) of Nokia in mobile telephony. The advance of smart phone technology then dramatically reduced Nokia's global lead in mobile handsets from the mid-2000s.

The GFC and other economic shocks (such as an ongoing recession in the Russian market, and declining demand for paper) compounded the effect of Nokia's decline on the Finnish economy. GDP fell by over 9% in 2009 and, after a brief recovery in 2010 continued to decline till 2015. Between 2008 and 2016 exports fell by 20%, with the share of high-technology exports falling from 23% in 2005 to 6% in 2016. With this dramatic change in the composition of production, total factor productivity fell more strongly than in most other OECD countries over the period.

From around 2010, successive new governments responded to these adverse shocks by substantially reducing and reconfiguring public support for private sector research and innovation (Deschryvere et al., 2021; OECD, 2017, 2022a). The OECD (2022a) commented that "[t]he rapid withdrawal of public funding for applied research and innovation collaboration weakened Finland's innovation ecosystems, especially by making it difficult for firms and universities to share the risks associated with the commercialisation of radical innovation" (p. 84).

The OECD (2017) argued that these changes reflected a loss of confidence in previous arrangements but were not guided by a clear strategy or view about how the Finnish economy would likely evolve

---

<sup>1</sup> "Tesi (officially Finnish Industry Investment Ltd) is a state-owned, market-driven investment company that invests in venture capital and private equity funds and directly in Finnish startups and growth companies. Tesi has an industry-focused mission aimed at promoting economic growth, innovation and investments" (Tesi, n.d.).

into new areas of competitive advantage. Subsequent governments have been reshaping innovation policies and governance in a way that corresponds to the OECD's recommendations.

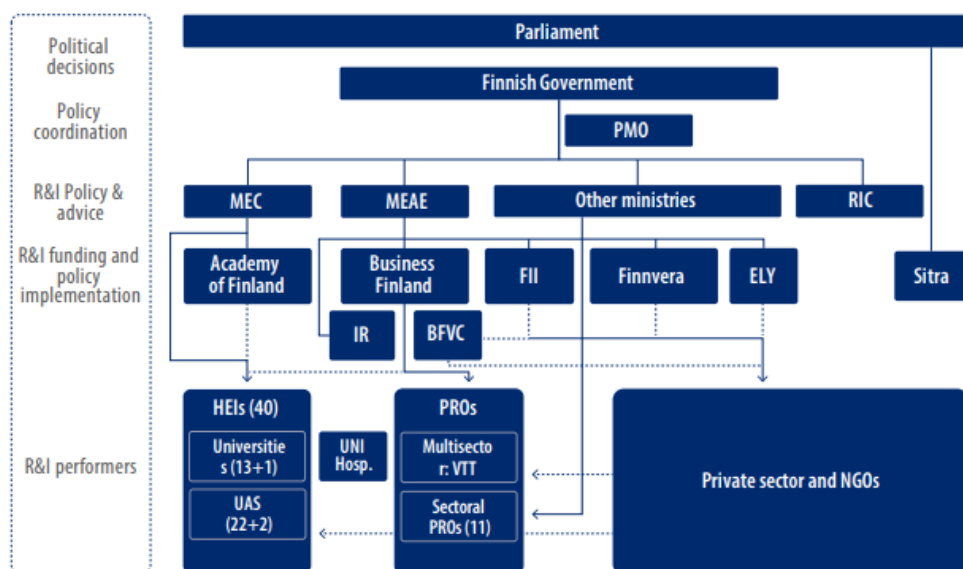
Adverse economic conditions following the GFC led to a decline in spending on R&D as a proportion of GDP from a peak of 3.7% in 2009. In 2010 Nokia alone accounted for 50% of business expenditure on R&D, but by 2015 this had fallen to 20% (with an additional 10% in Microsoft Mobile which took over part of Nokia's business) (OECD, 2017). Recent governments, with cross-party support, have reconfirmed an objective to increase gross domestic R&D spending to 4% of GDP by 2030, of which legislatively mandated public spending on R&D will be a third (Deschryvere et al., 2021; OECD, 2022a).

## 2.1.1 High-level governance

Arnold et al. (2022, p. 21) describe the governance of Finland's R&I system as typical for a Western European Country, with two pillars "resting on strong industry [the Ministry of Economic Affairs and Employment] and education [the Ministry of Education and Culture] ministries and their agencies ...Until about a decade ago Finland's system of R&I governance with an effective high-level advisory council was widely admired..."

Arnold et al. set out the governance arrangements in Figure 1.

**Figure 1: Structure of Finland's research and innovation system**



- BF = Business Finland
- BFVC = Business Finland Venture Capital Ltd
- ELY = Centres for Economic Development, Transport, and the Environment (Elinkeino-, liikenne- ja ympäristökeskukset)
- FII = Finnish Industry Investment Ltd
- HEI = Higher Education Institutions ([Universities](#) and [Universities of Applied Sciences](#))
- MEAE = Ministry of Economic Affairs and Employment
- MEC = Ministry of Education and Culture
- NIY = Young Innovative Enterprises funding service of Business Finland (Nuoret innovatiiviset yritykset -rahoituspalvelu)
- PMO = Prime Minister's Office
- PRO = Public Research Organisations
- RIC = Research and Innovation Council
- Sitra = the Finnish Innovation Fund
- IR = The Finnish Climate Fund Ltd
- VTT = Technical Research Centre of Finland – VTT Ltd

Source: Arnold et al. (2022, p. 21).



Business Finland was established in 2018 from a merger of Tekes (the National Technology Agency) and Finpro (Finland's Export Promotion Agency). Business Finland's role is to disburse innovation funding and promote trade, tourism and investment (OECD, 2022a).

The Academy of Finland's primary role is disbursing funding for research. Half its funding goes to academic research and various fellowship programmes, while the other half is allocated to thematic funding including Strategic Research Council programmes for multidisciplinary consortia (OECD, 2022a).

## The Research and Innovation Council

The Research and Innovation Council (RIC) (and its predecessors), chaired by the Prime Minister, has taken the lead in shaping overall innovation strategy. It has historically "acted as an arena for debating innovation policy priorities from a holistic perspective and forming a national strategic consensus ...it monitored the state of Finland's innovation system and supported strong coordination and high-level decisions" (OECD, 2022a, p. 87).

The RIC operates in a context where close networking across academic, government and industry players, and shaping of policy through representative councils is the norm. Historically the RIC has set the broad research and innovation policy agenda, with detailed implementation falling to the relevant ministries. Its influence depends greatly on the interest that the Prime Minister gives it (OECD, 2017).

The RIC fell into abeyance for some years following the economic crises of the mid-2000s and a new government's loss of confidence in the then current research and innovation policy settings. The RIC had promoted the Strategic Centres for Science, Technology and Innovation (SHOKs) which fell out of favour with a new government in 2015 (see below).

The government reconstituted the RIC in 2016. The RIC then had five members chosen from leading participants in the research and innovation system, joined by ministers from relevant ministries. The Council meets every two months.

*The relaunch in 2016 of the Research and Innovation Council (RIC), as well as the pooling of resources and research at the Government Policy Analysis Unit at the Prime Minister's Office, indicate[d] a renewed interest in horizontal policy coordination.*

Schwaag Serger and Palmberg (2022, p. 165)

In 2019 a new government again restructured the RIC.

*It is still chaired by the Prime Minister, the Minister of Science and Culture and the Minister of Economic Affairs are Vice-Chairs, and it contains three additional ministers appointed by the government. In addition to the ministers, the Council has six to seven other members appointed by the government based on proposals from the Ministry of Education and Culture for the duration of the parliamentary term. The members of the Council are required to have broad expertise in research, development, and innovation. The seven appointees currently comprise three people from business, three university professors (of whom, one rector) and the president of VTT [Technical Research Centre of Finland]. The Council's independent secretariat and two subcommittees have been abolished, and preparatory work assigned to civil servants within the Ministry of Education and Culture, the Ministry of Economic Affairs and Employment, the Prime Minister's Office, Tekes/Business Finland, and the Academy of Finland.*

Arnold et al., (2022, p. 22)

Arnold et al., noted that "the RIC is inherently less powerful than before. This has resulted in a loss of systemic perspective...no other body has been allocated the leading role in R&I policy that would make it possible to set clear strategic directions" (2022, p. 22).

The OECD commented “[t]here is a case for restoring the RIC’s original capabilities, especially the strong coordination power. The rejuvenated RIC can be a suitable body for overall planning, implementing and monitoring mission-oriented innovation policies...The RIC can also help ensure that private sector needs are adequately taken into account in government R&D funding and support measures...” (2022a, p. 87). Deschryvere et al.,(2021) made similar arguments about the need to revive strategic governance arrangements for Finnish innovation policy.

During 2022 a parliamentary working group developed proposals for the future use of research and development funding, including for the management and steering of the research, development and innovation system (Parliamentary RDI Working Group 2022, 2023). The Working Group outlined policy to strengthen the role of the RIC in the management and coordination of research and innovation policy, including assigning a full-time secretariat (of five staff) to it and strengthening “the position of the inter-ministerial network of officials responsible for RDI [research, development and innovation] tasks” who support the preparatory work of the RIC (pp. 33-35). The Working Group further proposed that the RIC lead work on national strategic choices “for the effective allocation of limited RDI funding... [and to] strengthen the capability to accelerate sustainability transitions and to develop internationally competitive clusters of competence as well as innovation and business ecosystems in selected regions” (pp. 42-43).

The newly established Orpo government in June 2023 announced its intention to implement the Working Group’s recommendations on the RIC (Finnish Government, 2023, p. 123).

## Setting strategic directions for research and innovation policy

In 2017, and consistent with OECD advice, the RIC developed a roadmap for strategic innovation policy (Research and Innovation Council Finland, 2017). Amongst other initiatives, the RIC envisaged the identification and development of “competence platforms and growth ecosystems” to accelerate the development of “new solutions”. The RIC signalled it intended to develop principles and procedures for making strategic choices of areas for focus (Research and Innovation Council Finland, 2017).

In 2020, a Ministerial Working Group on Competence, Education, Culture and Innovation adopted “a National Roadmap for Research, Development and Innovation (RDI)”. The two Ministries (MEAE and MEC) prepared this new roadmap taking account of the RIC roadmap and other documents. The National Roadmap sets out aspirations such as increases in the national level of competence and education, increases in business R&D, increased collaboration between businesses and researchers, and improvements in research infrastructure. Yet it does little to set out strategic priorities and concrete steps and measures to achieve those priorities (Ministry of Education and Culture Finland, 2020). The National Roadmap for RDI was updated in December 2021, but again did little to establish strategic priorities (Ministry of Education and Culture Finland, 2021).

*While statements of Finnish R&I policy increasingly connect with societal and environmental issues and the societal challenges, these changes in tone have not triggered policies that cut significantly across the existing silos or involve major new types of programmes or funding instruments.*

Arnold et al. (2022, p. 22)

Similarly, the OECD commented that “Finland needs a clear mission-oriented innovation policy that directs applied research and innovation activities toward solving the most pressing socio-economic challenges” (2022a, p. 69). The OECD identified a lack of synergy between the programmes of the Academy of Finland and Business Finland and that the Academy’s programmes lacked rigorous impact assessment and ongoing adjustment (p. 91).

### 2.1.2 Devolved governance

Prior to the 2008 crisis, the then Finnish Funding Agency for Innovation (Tekes) had partly funded several public sector and private sector collaborative innovation initiatives, and had a long history of funding technology development programmes.

## Strategic Centres for Science, Technology and Innovation

From 2008 to 2015, Tekes funded six industry-research collaborations (Strategic Centres for Science, Technology and Innovation – known as SHOKs). Annual public funding was €100 million (NZ\$173 million) at its peak and the combined total funding over the life of the programme was €1.1 billion (NZ\$1.9 billion). Participating companies contributed about one-third of total funding. The programmes included bioeconomy, energy, and metals, and focused on relatively near-to-market technology innovation. At its inception, the SHOK programme was in essence the Finnish government's "flagship" approach to promoting innovation to achieve international competitiveness (Lähteenmäki-Smith et al., 2013).

The SHOKs were set up as limited liability companies with shares held by participants in the collaboration. Each SHOK initiated technology development programmes for funding approval from Tekes. SHOKs represented an attempt to move beyond Tekes traditional technology development programmes, to a model that put much greater emphasis on building creative, self-governing innovation collaborations (Lähteenmäki-Smith et al., 2013).

The SHOKs initiative was largely built on previous cluster initiatives (Lähteenmäki-Smith et al., 2013). Of the six SHOKs, one (covering real estate and construction) resulted from bottom-up proposals for inclusion.

Evaluation found that the SHOKs faced multiple and often conflicting objectives, weak governance, lacked an adequate cross-disciplinary scope, and tended to focus on incremental innovation within existing models. While the evaluation recommended adjustments to the initiative, a new government in 2015 decided instead to discontinue it (Deschryvere et al., 2021; Piirainen et al., 2019). As a result, the government phased out direct public funding. Some programmes continued, drawing on other sources of public funding (OECD, 2017).

Ironically, the continuing and apparently successful Swedish Strategic Innovation Programmes were modelled on the Finnish programmes (OECD, 2016). A more recent qualitative evaluation of the SHOKs for Business Finland, found generally positive outcomes in terms of network building, development of technology platforms and technology standardisation, and strengthening of a culture of collaboration around innovation (Piirainen et al., 2019).

Tekes later financed an industry-based non-profit company, Digital, Internet, Materials and Engineering Co-Creation Ltd., to build a networked ecosystem of digital innovators to speed time to market. Digital, Internet, Materials and Engineering Co-Creation Ltd., was formed in 2016 from the amalgamation of two of the SHOKs (focused respectively on metals and engineering and on the internet economy). By 2020, the network comprised over 2000 R&D and innovation professionals, 400 organisations, 69 shareholders, and 10 co-creation facilitators. In 2016 Digital, Internet, Materials and Engineering Co-Creation Ltd., achieved a €50 million (roughly NZ\$86 million) research portfolio (DIMECC, 2020).

## Recent programmes to support devolved innovation collaborations

More recently, the Government has developed collaborative mission-led strategies to find knowledge-based solutions to societal challenges, including climate change (OECD, 2017). Some of these have an economic and competitive advantage dimension (such as in health technology and in biotechnology) while also addressing societal challenges.

*[from 2013] ...the main technology, innovation and industrial policy agencies (Academy of Finland, Tekes, Finnvera, Finpro as well as the think tank Sitra) joined forces to develop the so-called SUUNTAS strategy. The aim of this strategy was to shift the focus of policy implementation beyond individual projects and companies towards the joint facilitation of the emergences of new business ecosystems in promising thematic areas. The SUUNTA strategy also fully embraced the so-called Team Finland approach whereby all relevant policy agencies would ensure a better integration of funding and other services.*

Schwaag Serger and Palmberg (2022, p. 165)

The agencies funded collaborative programmes in cleantech, public infrastructure, healthcare and wellbeing as part of the SUUNTA strategy (Schwaag Serger & Palmberg, 2022).

Between 2016 and 2018 Tekes (now merged with Finpro to form Business Finland) ran its Bionets Programme to trial a way to fund an “orchestrator” to develop an innovation ecosystem towards “specified business goals” (Business Finland, n.d.-a; Palmberg & Schwaag Serger, 2017). “The aim was also to support the cooperation of individual companies in order to create new biobased solutions” (Business Finland, n.d.-a). Tekes drew proposals from potential bioeconomy participants through a three stage “bottom-up” process. As a result it funded five coordinators over a period of three years to develop initiatives covering new cellulose products, nutrient recycling, new uses for lignin, packaging innovations and textile recycling. The majority of the funding of €46 million (roughly NZ\$80 million) was allocated to companies, with some going to research organisations as coordinators. The intention was to catalyse continuation of the network after public startup funding had ended. The program was complementary to specific Finpro export promotion programs (Eaton et al., 2021).

During its operation, Bionets funded 130 specific projects. Company participants overall reported 67 patents arising from the program, and a majority introduced new products and new technology services; while 60% increased collaboration with other partners, 35-40% increased collaboration with other domestic and international companies. The trial to orchestrate ecosystem development evolved into new successor programs (Eaton et al., 2021).

In 2020 and 2021, Business Finland launched its Challenge Competitions, directed to large leading firms (such as Nokia, Neste and Sandvik) to address major future challenges. 67% of the funds of €180 million (NZ\$316 million) were subcontracted to small and medium enterprises, and to research institutions. In return, the large firms committed to boosting R&D and other innovation investments by €870 million (NZ\$1.5 billion).

Business Finland also takes a similar approach to funding co-innovation efforts aimed at creating new international businesses or increasing export competitiveness. “Growth Engine” funding, for example, aims to build new billion-Euro export businesses in Finland “implemented through an enterprise-driven partnership model between companies, research organizations and public actors, which strives to find solutions to global market disruption and create new growth sectors in Finland” (Business Finland, n.d.b). More generally, Business Finland operates a loan programme for innovation projects and requires large firms receiving subsidised loans for innovation to outsource 15% of project costs to SMEs or research institutions (OECD, 2022a). This strategy reflects Business Finland’s intention to strengthen innovation ecosystems around leading large companies (Business Finland, 2022).

### **2.1.3 Assessment of governance arrangements**

Finland has for decades employed high-level and devolved governance arrangements to shape its focused innovation policies. A culture of collaboration for innovation, evaluation of outcomes, and adjustment of effort and direction is strongly embedded. Other countries have drawn on Finnish models of high-level governance (the National Innovation Council) and devolved-governance (for example, the Strategic Centres for Science, Technology and Innovation) to design their own approach to focused innovation policy (Fagerberg & Hutschenreiter, 2020).

More than the other countries in this study, Finland faced a dramatic deterioration in its economic circumstances following the decline of Nokia and the onset of the GFC in the mid-2000s. A new government of the day reacted to these circumstances by curtailing the role of the National Innovation Council (NIC) and discontinuing the Strategic Centres for Science, Technology and Innovation (SHOKs). Yet a culture of collaboration through devolved governance arrangements endured in other forms to implement focused innovation policy. Section 1.4 describes how the city of Oulu governed responses to the decline of Nokia, and section 2 shows how other collaborative initiatives built on the SHOKs. Subsequent governments have also recognised the value of the NIC, and with cross-party support have acted to restore its role and capabilities in steering Finnish innovation effort.

Evaluation of devolved collaborative initiatives show that they have been successful in increasing collaboration on innovation across businesses and research organisations, and in raising innovation outcomes. Evaluations find a tendency to incremental rather than radical innovation.

## 2.2 Denmark

Denmark has an outward-looking economy and a highly sophisticated business sector, which has a strong presence in food, logistics services, and pharmaceuticals, as well as the creative economy. Denmark has also emerged as a hub for innovation in wind energy and robotics. Its innovation system is high performing, with particular emphasis on R&D in life sciences, where Denmark is a world leader (Independent Experts Panel, 2019). Danish R&D intensity is above the OECD and EU28 averages at three percent of GDP (Christensen & Knudsen, 2021). In 2023, Denmark overtook Sweden as the top innovator in the European innovation scoreboard (European Commission, 2023). These achievements reflect strengths such as a highly innovative business sector, a skilled workforce, and world-class research capabilities.

While world leading, Business R&D is increasingly concentrated in a small number of large Danish companies (such as in pharmaceuticals, wind energy and robotics) (Independent Experts Panel, 2019). Questions exist around how well Danish firms translate R&D into practical innovation and around overall slow productivity growth in the last decade (Christensen & Knudsen, 2021; OECD, 2019).

The Ministry of Higher Education and Science and Ministry of Industry, Business and Financial Affairs together support knowledge-driven innovation and its translation into commercial results. There is a wide range of institutions for collaborative research and innovation, including universities, other higher education institutions, and seven research technology organisations (RTOs), enjoying both public and private sector funding support. The Danish approach has included a focus on innovation networks and clusters and Denmark ranks well on measures of multi-stakeholder collaboration for innovation. Over the last decade, the Danish government has been consolidating its innovation policies by reducing redundancy in policy instruments and institutional scope (Independent Experts Panel, 2019).

The Innovation Fund Denmark (IFD), operating under the supervision of Ministry of Higher Education and Science, funds earlier stage business focused research and innovation. Denmark's Export and Investment Fund, operating under the supervision of Ministry of Industry, Business and Financial Affairs, was established in January 2023 by merging the Danish Growth Fund, the Danish Green Investment Fund, and EKF Denmark's export credit agency (Innovayt, 2023). The fund provides a single point of access to government-backed equity funding for entrepreneurs, SMEs, and large export companies (Export and Investment Fund of Denmark, n.d.).

Private foundations, often associated with large international firms, fund a significant share of Danish research (Independent Experts Panel, 2019). For example, the Novo Nordisk Foundation awarded grants worth DKK7.5 billion (NZ\$1.8 billion) in 2022 to areas such as biomedical and health sciences, life science research, sustainable development, innovation and social and humanitarian issues (Novo Nordisk Foundation, 2022).

### 2.2.1 High-level governance

Over the last decade, the Danish Government has set up and received advice on innovation policy from a short-term Productivity Commission (operating from 2012 to 2014), and the Danish Disruption Council (operating from 2017 to 2019 with a focus on policies to tackle the labour market effects of new technology) (Thormann, 2017). The government periodically launches short-term strategies touching on aspects of science, innovation and economic performance (Independent Experts Panel, 2019). Despite this, Denmark's innovation policy lacks lasting high-level strategic governance arrangements spanning stakeholders across industry, knowledge institutions and government (Independent Experts Panel, 2019).

*Although the relevant ministries are in an ongoing dialogue, a clearly visible formal platform for coordination of strategic efforts related to innovation at the highest level of government does not seem to exist. Much of the coordination across institutions is done informally. This approach to coordination is aligned with the country's small size and cooperative culture, and it is working, to some extent at the operational level. But there has been a tendency to minimise the need for coordination across different parts of the system by defining clearly separated areas of responsibility.*

Independent Experts Panel (2019, p. 47)

The Independent Experts Panel recommended that the Government develop a comprehensive innovation strategy. The review framed this as a way of building on the strengths of an already “highly sophisticated and well-developed support system for innovation” (p. 39). The review panel argued that a national strategy should involve high-level political commitment, broad engagement with stakeholders and an all-of-government approach. The strategy should focus on “systemic dialogue and collaboration across the entire innovation system” and “systemic integration of individual innovation policy tools towards common goals” (Independent Experts Panel, 2019, p. 15).

The review identified the option of “a powerful national innovation council as a strategic decision-making body” to pursue such a strategy (p. 116). Such a council could be set up by broadening the mandate of the existing Danish Council for Research and Innovation Policy (DFiR).

## **The Danish Council for Research and Innovation Policy**

DFiR replaced the previous Danish Council for Research Policy in 2014 and took over the advisory tasks of the Danish Council for Technology and Innovation (Danish Council for Research and Innovation Policy, 2023). DFiR is responsible for providing independent and expert advice to the Ministry of Higher Education and Science on research, technological development, and innovation. The DFiR does not have a role in advising on or setting strategic directions in innovation policy, or in policy coordination (Borowiecki & Paunov, 2018).

DFiR comprises nine members appointed by the Minister for Higher Education and Science. Most have backgrounds in academia or one of the private research foundations, and serve for a period of three and up to six years. An independent secretariat of the Council is placed within the Ministry of Higher Education and Science to assist with its operations.

A core function of the council is to evaluate the general development, quality, and societal relevance of Danish research, technology development, and innovation in an international context which is shared via reports published annually.

## **Innovation Fund Denmark**

Innovation Fund Denmark (IFD), is an independent council, established in 2013, with a current annual budget DKK 1.7 billion (NZ\$403 million) (Innovation Fund Denmark, 2023c). IFD defines its purpose as to “accelerate... research and innovation to solutions that strengthen the competitiveness and sustainability of the Danish society” (Innovation Fund Denmark, 2021, p. 3).

*Innovation Fund Denmark invests actively in ideas, knowledge and technology as well as catalyzes cooperation and partnerships between researchers, entrepreneurs and companies with the aim to create value and jobs.*

Innovation Fund Denmark (2021, p. 3)

The IFD Board comprises nine members with business, academic and technology backgrounds, who serve for three-year terms. It has an independent secretariat of 16 staff to support its work (Innovation Fund Denmark, n.d.).

In recent years, the fund has developed a focus on finding solutions to societal challenges (Innovation Fund Denmark, n.d.). This appears in part to be a response to the recommendations of the Independent Experts Panel that the IFD have a mandate and mission to develop a systemic multi-

partner, multi-project innovation agenda in areas of strategic importance (Independent Experts Panel, 2019, p. 72).

## 2.2.2 Devolved governance

Denmark has experimented with “cluster” arrangements for collaborative innovation initiatives involving business, research and government organisations for more than two decades. Many of these emerged with central and regional government support through competitive funding processes. Since 2003, the scope of clusters has progressed from regional growth policies and technology centres and innovation networks, through more formalised regional clusters, and now to 13 well-defined national clusters.

### National Innovation Clusters

Cluster Excellence Denmark, a private company, tendered and was appointed in 2013 to lead the development of national clusters from 2014 till September 2023 (Cluster Excellence Denmark, n.d.-a). Around 2019, the Danish government moved to consolidate the numerous regional and national clusters, into a smaller number, to achieve efficient scope and scale and to avoid duplication of effort.

First, the Danish Board of Business Development (an agency of the Ministry of Industry, Business and Financial Affairs) defined areas of economic strength or “strongholds” for the Danish economy. Then the Ministry of Higher Education and Science used a competitive process to choose the 14 (now 13) best clusters for government support and promotion (Independent Experts Panel, 2019). Clusters include technologies and economic activity such as the life sciences, digital technologies, energy, construction, food, maritime, cyber security and robotics (Cluster Excellence Denmark, n.d.-b).

*The core task of the clusters is to support activities that promote collaboration on innovation, including knowledge-based innovation, between companies and research and knowledge institutions, as well as other actors in their entire ecosystem. The cluster organizations strive to strengthen the overall ecosystem's ability to increase the companies' innovative power.*

Ministry of Higher Education and Science (2023)

During consolidation, cluster organisations refined their governance model based on experience. They are now membership-based bodies, with independent boards, and with different types of members paying different fees. Members range from large corporations and academic institutions, through regional organisations to smaller businesses and individuals.

For example, the Food & Bio Cluster Denmark was created through a merger of four long-standing organisations in the food and bioresource industry (Food & Bio Cluster Denmark, n.d.). The board of Food & Bio Cluster Denmark currently comprises 14 members from private companies, industry associations, and universities. The cluster's activities include organising events for members on new knowledge and trends, creating networking opportunities, fostering collaborative projects, and offering one-on-one professional advisory services.

The Ministry of Higher Education and Science is supporting the operation of the 13 clusters with funding of DKK640 million (NZ\$151 million) for the period from 2021-2024 (OECD, 2022b). Government funding for running core cluster activities (promoting stronger cooperation with the cluster and between cluster firms and external organisations) is limited to four years (OECD, 2022b).<sup>2</sup> Other activities are based on project funding, membership fees, and private financing, including funding from national government initiatives, EU-funded programs and from private foundations.

### Clusters response to the COVID-19 crisis

During the COVID-19 pandemic, Cluster Excellence Denmark published a discussion paper on “Rethinking innovation: Danish Clusters’ response to the COVID-19 crisis” (Lysgaard, 2020). The paper discusses how standard “cluster tools” such as match making, research partnerships,

---

<sup>2</sup> EU state aid rules permit the basic funding of innovation clusters for up to 10 years (OECD, 2022b).

incubation and internationalisation and others can be used during and after the crisis. The paper found that clusters were successfully adapting their existing tools in new ways during COVID-19.

*Danish clusters show agility in relation to the new situation, and together with their member companies they are in the process of developing and implementing new activities that can support businesses: From innovation collaborations with the healthcare sector, over handheld help for troubled sectors to hotlines for entrepreneurs and businesses.*

Cluster Excellence Denmark (2020, p. 1)

## The Innomissions Programme

The Danish Government through Innovation Fund Denmark (IFD) established the Innomissions programme in 2023 with funding of DK700 million (NZ\$174 million), supported by European Union funding. The programme invited proposals for public-private partnerships that would contribute to reducing Denmark's greenhouse gas emissions by 70% by 2030, and to achieve net-zero emissions by 2050. IFD awarded funding to four partnerships covering collection, storage or use of CO<sub>2</sub>; green fuels for transport and industry; climate and environmentally friendly food production; and creating a circular economy with a specific focus on plastics and textiles (Innovation Fund Denmark, 2023b). The programme aims, at the same time, to increase the competitiveness of Danish businesses.

An independent board governs each partnership, comprising research and technology institutes and private companies. Each board allocates funding for specific projects within its ambit, subject to IFD's funding guidelines. IFD funding is up to 75% of the costs of each project and all project participants must invest in the project (with private investment rates varying by the type of participant and the type of project) (Innovation Fund Denmark, 2023a).

### Box 2 Resilience in the Danish AgriFood System

Chatzopoulou and Karantininis (2022) identified three key characteristics of the Danish AgriFood System that enable innovation, resilience, and adaptability during crises - collaborative governance structures, cooperative organisations within the sector, and high levels of professionalism and social capital. The Danish AgriFood System has demonstrated significant resilience and adaptive capacity in response to emerging challenges such as the Eurozone crisis, climate change, the COVID-19 pandemic, and the EU's common agricultural policy reforms.

Collaborative governance structures, involving the government and agrifood sector businesses and industry organisations, support adaptation and the adoption of new solutions. Cooperative organisation of the sector under a single umbrella organisation (the Danish Agriculture and Food Council) enables conflict resolution and consensus-driven decisions. The sector has high levels of professionalism and social capital, which supports identifying new strategies and developing viable, innovative long-term solutions. This, in turn, helps the sector to remain competitive and respond to new demands.

## 2.2.3 Assessment of governance arrangements

Denmark has well-developed arrangements for the devolved governance of focused innovation policy, but lacks a single, high-level body to steer innovation effort. Informal networks in the context of an enduring cooperative culture and the presence of private foundations centred on large-multinational research-intensive companies may compensate in part for the lack of a high-level body.

Recent reviews of the Danish innovation system have identified a lack of strategic prioritisation across policy arenas, and across different technologies and areas of the economy. This has become more important as the government has given increasing attention to tackling broad societal challenges that involve many areas of the economy and society.



After decades of experimentation, national cluster organisations are now the main form of devolved governance of focused innovation policy. Clusters are membership-based organisations, with short-term government support in their initial stages. Clusters aim to build collaboration on innovation amongst members. The short-term government funding for specific projects means that, compared to some SAEs, Danish clusters may lack sufficient support for longer-term strategic innovation initiatives (OECD, 2022b).

Clusters have proved useful collaboration platforms during crises, despite the lack of an overarching national strategy. A strong commitment from governments has supported the development of networks that can adapt to shocks.

Partly in response to reviews, Innovation Fund Denmark now funds the Innomissions programme through four independently governed public-private partnerships. The programme is focused on tackling the challenges of climate change. The governance model is similar to that developed in Finland for the Strategic Centres, for Research, Science and Innovation, and later adopted by Sweden for its Strategic Innovation Program.

## 2.3 Sweden

Sweden has a long history of state support for chosen industries, through tariff protection, subsidies, public R&D to aid adoption of new technologies and direct acquisition of such technologies (Berg & Bruland, 1998; Chang, 2002). Public-private cooperation in the development of chosen industries endured through the 20<sup>th</sup> century, associated with the emergence of large world-class firms such as Ericsson (telecommunications) and ASEA (specialising in railway equipment and electrical engineering, and now part of the multinational Swedish-Swiss firm ABB).

Since the 1940s, Swedish universities have played a central role in applied industrial research involving cooperation with firms. Much of the effort was focused on so-called “developmental pairs” in which substantial university research served the needs of large technologically advanced Swedish companies. In contrast Swedish research institutes have played a relatively minor role in applied industrial research. Rather they have tended to work in specialised areas not covered by university research (and lacking large research-intensive firms) (OECD, 2013, 2016).

The presence in Sweden of large international firms in high-tech sectors such as telecommunications, electrical machinery, transport equipment, and pharmaceuticals has stimulated high overall levels of investment in R&D. Since the mid-1990s, Sweden's R&D spending as a share of GDP has varied from a high of 3.9 percent in 2001 (just before the IT bubble burst), to a low of 3.1 percent in 2014 (Schwaag Serger et al., 2023).

Sweden, for at least 80 years, has had relatively autonomous agencies and councils to facilitate and fund collaboration between government, private sector businesses and industry organisations, and academia (Fagerberg & Hutschenreiter, 2020). Vinnova, the Swedish Governmental Agency for Innovation systems, established in 2001, is the most recent example. Another agency, the Swedish Research Council, funds universities to undertake research.

Research bills presented to parliament every four years govern research funding. The bills provide for new funds or reallocate existing funds. These bills also govern innovation policies based on research.

In preparation for the next bill, scheduled for presentation in 2024, a parliamentary committee is currently inquiring into the structure and organisation of research funding (Vinnova, 2023). The inquiry commissioned Ingrid Petterson, the chair of the board of Lund University, to lead a report into the organisation of funding for research and innovation, assisted by advice from the OECD. Concerns revolved around the fragmentation of funding among numerous research funding agencies, which did not support a strategic approach of sufficient scale to tackle societal challenges (OECD, 2023; Upton, 2023).

As a result, in October 2023, the Petterson report recommended that the Swedish government establish three new funding authorities, the Swedish Research Agency, the Swedish Agency for

Strategic Research, and the Swedish Innovation Agency. It recommended that these replace the current authorities – the Swedish Research Council for Sustainable Development, the Swedish Research Council, and Vinnova (Forskningsfinansieringsutredningen (Research Funding Inquiry), 2023). This foreshadows potentially significant changes to funding of innovation policy in Sweden.

A unique feature of Sweden is its “dualistic” governance system with relatively small ministries and much larger autonomous agencies (Petridou, 2020). Under its long-standing constitution, Sweden does not have formal ministerial rule over the operation of agencies. Although agencies belong to a specific ministry, public agencies and civil servants have considerable freedom in interpreting laws or exercising public authority. However, the law does not bind governments to follow agencies’ recommendations. Governments usually have done so because people view decisions made by public agencies as depoliticised and based on evidence and expertise.

Dualism in the Swedish system refers both to the clear separation between political ministries and non-political agencies, and to the way the constitution uniquely enshrines this separation (Levin, 2009). While many countries have granted administrative bodies greater autonomy over the years, nowhere else is the entire administrative structure built around delegation of power. This dualistic governance system may in part explain the enduring nature of devolved decision-making arrangements within the Swedish research and innovation system.

### **2.3.1 High-level governance**

The National Innovation Council (NIC), established by Prime Minister, Stefan Löfven, in 2015 and discontinued by a new government in 2022, played a central role in setting Sweden’s innovation policy agenda. It had a wide remit covering innovation policy beyond research policy, though it also considered research policy relevant to innovation. As a result, its work overlapped with that of the longstanding Research Council.

#### **The National Innovation Council**

The National Innovation Council (NIC) consisted of ten expert advisors from industry, the unions, and academia, who acted in their individual capacity. The Prime Minister chaired the council meetings, attended also by other Ministers, including the Minister of Enterprise/Innovation, the Minister of Research, and the Minister of International Development Cooperation and Climate. The NIC had a small secretariat of four, which was placed under the umbrella of the Office of the Prime Minister, elevating its position (Edquist, 2019).

The NIC convened four times a year to consider an agenda put together by the Principal Secretary of the Council and the Secretariat. External members of the Council could also suggest agenda items. The Prime Minister was actively involved in deciding the agenda.

After each meeting, State Secretaries (deputy ministers of the five ministers involved) participated in follow-up discussions to determine which policies to implement and how to carry out the implementation process across various ministries and public agencies. The State Secretary of the Prime Minister served as the chairman of the implementation group.

The NIC helped shape Sweden’s innovation strategy. For example, the Council identified three future challenges (digitisation, life science and environmental and climate technology) for Vinnova’s Collaboration for Research and Innovation program (a complement to the Strategic Innovation Program, discussed below) (Åström et al., 2021).

A wide range of topics related to innovation policy were discussed at meetings. Some examples included risk capital provision by the state, innovation partnership programmes, and the issue of additionality in innovation policy making (Edquist, 2019). Edquist argued that the Prime Minister’s leadership partly explained the quick implementation of a public risk capital company within 18 months of discussion in the NIC.

## 2.3.2 Devolved governance

### Strategic Innovation Programs

In 2012, the Swedish government tasked Vinnova, the Swedish Energy Agency, and the Swedish Research Council for Sustainable Development (Formas) to create the Strategic Innovation Programs (SIPs) (Schwaag Serger & Palmberg, 2022). The initiative aims to enhance the global competitiveness of Sweden's economy and promote sustainable solutions to worldwide challenges by fostering interactions between universities, businesses, civil society organisations, and government agencies through an innovation system approach.

The three agencies have formed a joint steering group to manage the SIP initiative overall. Each agency takes responsibility for the administration of specific SIPs based on their respective thematic areas. The Program Officers for each SIP and the members of the steering group meet regularly to coordinate policies, administration, communication, and budgets across the portfolio of SIPs (OECD, 2020b).

#### Selection of SIPs

The three agencies used a two-phase bottom-up process to shape the choice of SIPs. In the first phase, groups formed consortia around research topics of strategic interest to them and applied for the status of a strategic innovation agenda (Paunov & Borowiecki, 2018). Over one hundred strategic innovation agendas were completed during this phase. The funding agencies provided seed funding to help with this process.

In the second stage, the agencies called for proposals for SIPs from consortia who had completed strategic innovation agendas that met specific standards. Four calls were launched, resulting in the selection of 17 SIPs for funding. Independent experts were involved in the selection.

Stakeholders sometimes went through an iterative process with the agencies to define SIPs. In some cases they amalgamated initially separate proposals to make them more attractive to the funding agencies (OECD, 2016).

This process allows innovation actors to define priority areas, with the government facilitating the process and establishing a framework of selection criteria (OECD, 2016). The criteria reflect societal challenges, high scientific quality, cross-disciplinarity, and co-financing.

#### Governance and funding of SIPs

One of the key features of the initiative is the significant decentralisation and outsourcing of responsibilities for the formation and implementation of strategic innovation agendas. Each SIP has its own board and management team, located in a Program Office hosted by one of the collaborating partners – usually a university, industry association or private company. Board chairs similarly come from different stakeholder backgrounds. The funding agency responsible for the SIP attends board meetings.

Uppsala University, for example, hosts the Program Office for the SIP "Internet of Things", which also includes larger companies like Ericsson, as well as smaller firms such as Sigma Connectivity and Teyi Services (Paunov & Borowiecki, 2018). Other higher education and technology institutions and industry organisations participate in the program – such as Teknikföretagen, the Royal Institute of Technology, Malmö University, and the Swedish Electronics Trade Association.

Each SIP is awarded funding to undertake a program of innovation initiatives. Boards have a substantial role in defining the scope of SIPs and in bringing forward projects for funding under criteria established by the funding agencies. Funding agencies have the final decision on funding specific projects. Even so, much of the traditional role of the funding agencies is devolved to the boards of SIPs (OECD, 2016).

The program has a long-term horizon, with SIP programs running for up to 12 years, and initial funding provided for three years with extension of funding subject to review. The 17 SIP programs can

run up to 2029, with total government funding projected to amount to around €800 million (over NZ\$1.4 billion) (Schwaag Serger & Palmberg, 2022).

### Evaluation of SIPs

Independent experts evaluate the SIPs every three years. The first evaluation focused on the process of forming the SIPs, while subsequent evaluations are assessing outcomes in terms of collaboration, international links, competitiveness and contribution to the Government's defined missions (Vinnova, 2020).

Fridholm and Hjorth (2022), in their summary of the nine-year evaluations of the SIPs, conclude that the initiative has led to projects that might not have been possible otherwise. They note: "significant parts of the added value of the programs can be traced to the efforts of the program offices and the projects that the program manager themselves can initiate" (2022, p. 13). Devolution of decisions enables Program Offices to manage the development and diffusion of research-based knowledge and gives them the resources to use that knowledge for strategic purposes. Program Offices also function as platforms for dialogue and coordination among program partners.

In their evaluation of SIPS after six years, Åström et al. (2021) found that the SIPs had been successful in supporting incremental innovation that would increase firms' competitiveness, but had been less successful in marshalling societal resources to tackle big challenges. They argued that the primary focus of SIPs (or the next instrument) should shift towards addressing specific societal challenges. First, this would require a clear and specific vision that is aimed at solving a particular problem, rather than being focused on the development of a specific industry or technology. Second, an approach focused on societal challenges is less likely to be hindered by incumbents trying to prevent change.

## Challenge-Driven Innovation Program

In response to the 2009 Lund Declaration,<sup>3</sup> Vinnova launched the Challenge-Driven Innovation Program in 2011 to support long-term collaboration on projects to solve societal challenges. Since 2018, projects must contribute to Sweden achieving one or more of the UN's Sustainable Development Goals.

The Challenge-Driven Innovation Program provides funding for companies, institutes, universities and public sector actors in three stages - initiation, collaborative projects, and follow-up investment. As of January 2020, Vinnova had funded 731 projects with a net funding of nearly €200 million (NZ\$352 million), or around €22 million (NZ\$39 million) each year. Universities received 35% of the funding, private companies 28%, and research institutes 16%. The focus is on "boundary-transcending collaborations," achieving systematic change, and international reach (Schwaag Serger & Palmberg, 2022, p. 160). As the phases progress, funding increases, with fewer projects funded, and a greater requirement for co-funding.

Sweden is currently reorganising its funding for research and innovation (see above) and is phasing out the Challenge-Driven Innovation Program. A recent evaluation found that the concept was "fundamentally successful" but identified several obstacles or weaknesses that are common to many such challenge-driven initiatives (Ramboll Management Consulting, 2022, p. 32). These include lack of clarity in projects about objectives, legal barriers to implementing solutions, and lack of an organisation taking responsibility for the uptake or dissemination of project outcomes. The evaluation found a need for clearer governance of projects that could test solutions to "concrete problems" more clearly defined than the Sustainable Development Goals.

---

<sup>3</sup> In 2009 the Lund Declaration emphasised the importance of research on societal challenges and the need to go beyond thematic approaches in implementing such research (European Union, 2009).

### **2.3.3 Assessment of governance arrangements**

From 2015 to 2022, the National Innovation Council played a central role in steering Sweden's innovation effort. The prime minister was closely involved in setting its agenda and ensuring follow up to implement its advice. It appeared to provide an effective platform for identifying and responding to the important issues facing innovation policy. Even so, a new government has taken a different approach to steering national innovation effort.

Since the commencement of a new government, the Swedish parliament has identified fragmentation of funding for research and innovation as a barrier to tackling societal challenges that span large parts of social and economic activity. The government is, as a result, progressing a bill in 2024 to reorganise funding for research and innovation, and to reform the main funding organisations.

The Strategic Innovation Programs (SIPs) are a long-lasting and well-evaluated devolved approach to governing focused innovation policy in chosen areas. Evaluations show that the SIPs have been successful in building collaboration on innovation across programme partners, and have succeeded in increasing innovation with a prospect of commercial outcomes, albeit of an incremental kind.

The OECD (2023) found, in the context of the SIPs, that bottom-up consensus building approaches in the absence of any top-down government involvement are "inherently conservative". Instead, it argued that "sponsors or funding agencies can play an important role in maintaining a balanced risk portfolio and ensuring attention to potentially disruptive areas of future interest" (p. 26). The Swedish government aims to address this issue through its current reforms to the organisation of funding for research and innovation.

## **2.4 Netherlands**

The Netherlands has a highly diversified, advanced economy, with strengths in knowledge-intensive services such as logistics, legal and financial services, and engineering (Fagerberg & Hutschenreiter, 2020). Its role as a gateway and hub for international trade with continental Europe contributes to these strengths (Box 3). Food processing, chemicals, petroleum refining, and electrical machinery are also major industries in the Netherlands.

The Netherlands has ranked in the top 10 on the Global Innovation index over the past decade (World Intellectual Property Organization, n.d.). Strong connections exist between universities, research institutes, industry, and advisory bodies, as well as with municipal, regional, and national governments. Dutch universities produce a high quantity and quality of research and engage with industry through regional clusters, such as Wageningen University's Food Valley (Foodvalley, n.d.). Public research institutes, such as the Netherlands Organisation for Applied Scientific Research, also make a large contribution especially through connections with business (OECD, 2014).

Both universities and large businesses are well connected internationally. Large R&D intensive, multinational enterprises, such as Philips, have a global presence. Yet business R&D expenditure and patenting is highly concentrated in the top ten firms. As a result, compared to other advanced countries, business R&D expenditure overall, is relatively low (OECD, 2014).

### **Box 3 Strengths of the Dutch innovation system**

**Geography:** The Netherlands is a densely populated country, strategically located close to major western European powers, with a well-educated workforce. The high concentration of talent attracts new talent, and start-ups thrive in its urban clusters.

**High connectivity:** The Netherlands has heavily invested in creating strong connections across physical, international, and organisational boundaries. The strength of these connections among actors in the innovation ecosystem enables high levels of collaboration.

**The Dutch Polder Model:** The Netherlands has a unique approach to tackling challenges, involving consultation, consensus, cooperation, and bottom-up innovation reflecting a distinctive Dutch culture that has developed over centuries (Saarloos & Dijck, 2017). A culture of ‘friendly competition’ and collaboration is well established in the Netherlands innovation ecosystem.

As with other northern European countries, the Netherlands has a strong tradition of consensus-oriented policy making (Box 3). Consensus emerges bottom-up through consultations among academics, business organisations and trade unions. “The process tends to work against attempts at “top-down” steering and instead provides for “negotiated change” in innovation policy and its governance” (OECD, 2014, p. 185).

The Ministry of Economic Affairs and Climate Policy and the Ministry of Education, Culture and Science are the main actors responsible for designing innovation policy. Under the Ministry of Economic Affairs and Climate Policy’s umbrella, the Netherlands Enterprise Agency administers R&D tax credits and other innovation and international business programmes. The Ministry of Economic Affairs and Climate Policy also partly funds the Netherlands Organisation for Scientific Research, the Technology Foundation, applied research institutes, and some research programmes at Wageningen University.

The Ministry of Education, Culture and Science funds higher education, mostly through block funding to institutions, with some additional funding for research areas of social or economic importance. It is also the major funder of the Netherlands Organisation for Scientific Research and the Royal Academy of Arts and Sciences.

The Netherlands Organisation for Scientific Research primarily funds academic research, through eight divisions (including the Technology Foundation) and three foundations. Nine research institutes fall under its umbrella. The Technology Foundation funds research programmes in technical services, with a focus on knowledge transfer from researchers to businesses. The Royal Academy of Arts and Sciences funds basic research.

The Netherlands has adopted varying approaches to innovation policy over the last 50 years. In the last 20 years it has shifted from a generic approach to one that aims to build critical mass in selected areas of the economy and technologies. In the 2000s, the Government focused attention on 10 “innovation programmes” including “flowers and food”, “high-tech systems and materials” and “chemistry” (OECD, 2014).

## **2.4.1 High-level governance**

The Netherlands, currently and for most of the past, has lacked a high-level governing body responsible for agenda setting, longer-term orientation, and system-level priority setting for science and innovation policy (OECD, 2014). Instead, a range of long-standing advisory bodies operate in accordance with the Dutch tradition of consensus-based policy making (described above).

However, for a period of seven years from 2003, the Netherlands government maintained the Innovation Platform, a taskforce-like organisation, to set high-level agendas for innovation. Based on the Finnish Research and Innovation Council (see above), it consisted of 18 members including top-

level government representatives (the prime minister and ministers for economic affairs and education and science), business representatives, knowledge experts, and others (Fagerberg & Hutschenreiter, 2020; OECD, 2014). Though the Platform had the status of a cabinet committee, members had high levels of autonomy, and the vote of the ministers was not decisive. Ultimately, it was not successful in commanding resources for implementing change. A new government abolished it as part of a wider change in policy (Fagerberg & Hutschenreiter, 2020).

Among other bodies, the Advisory Council for Science, Technology and Innovation is an independent policy think tank that has existed for over 50 years in some form (Schwaag Serger et al., 2015). It provides advice to the government and parliament on policies related to scientific research, technology development and innovation. The Ministry of Economic Affairs and Climate Change Policy and the Ministry of Education, Culture and Science together fund the Council.

The Advisory Council for Science, Technology and Innovation has a maximum of 10 members from research institutes, trade, and industry, chosen for their expertise rather than representation of their organisations. The council currently has a secretariat of five scientific staff and four supporting staff (Advisory council for science, technology and innovation, 2021).

## 2.4.2 Devolved governance

### The Top Sectors

From 2010, a new government adopted the Top Sectors policy to strengthen competitiveness through innovation, internationalisation, and human capital development (Janssen, 2019). The policy aimed to achieve this through better coordination among business, government and public research and education institutions in the chosen areas of the economy. The chosen sectors often had a history of public and private collaboration initiatives to strengthen innovation, sometimes from the 1980s (Fagerberg & Hutschenreiter, 2020; OECD, 2014).

The Top Sectors comprised Agri-food, Horticulture and propagation materials, High-tech systems and materials, Energy, Logistics, Creative Industry, Life Sciences, Chemicals and Water (OECD, 2014). The nine sectors were very broad, covering around 90% of business R&D and 30% of value added and of employment in the economy.

For each Top Sector, Top Teams, comprising high-level representatives from industry, public research and government, developed draft Knowledge and Innovation Agendas. Agendas included a strategic plan and proposed instruments to make progress against the plan. The Government evaluated each proposed Agenda against criteria such as level of ambition, commitment of stakeholders, openness, the balance between social and economic objectives and the extent to which progress could be monitored and evaluated. The parties formalised the relationships and sectoral plans through bi-annually updated innovation contracts. Each Top team has a secretariat and an advisory board (Arnold et al., 2018).

Top consortia for knowledge and innovation (TKIs) implement the innovation contracts. Some of the Top Sectors cover more than one TKI and some TKIs (eg, on ICT, nanotechnology and the bioeconomy) are cross-cutting (OECD, 2014; van der Wiel & van der Kroon, 2014). In total there were originally 19 TKIs. Both the government and businesses provide funding for the operation of the TKIs. In 2013, private funding for TKIs was roughly four times as large as public funding.

TKI staff take the lead on joint research activities, engaging with stakeholders and coordination of Knowledge and Innovation Agendas (Janssen, 2020). TKI staff also organise networking activities and other initiatives to help stakeholders develop and apply innovations.

TKIs administer a 30% top-up for firms' spending on public-private research collaboration. They also provide direct funding for networking and advice, and support for small and medium firms to participate in prototyping and feasibility studies. Public funding for TKIs, including subsidies, amounted to €130 million (NZ\$228 million) in 2017 (OECD, 2020a). The private sector finances more than half the investment in TKI projects, which is a core goal of the policy (Dialogic, 2017).

The Top Sectors approach takes a systemic perspective on innovation. It aims to tailor cross-economy policies, such as regulatory systems, the provision of support for basic and applied research and development, the provision of infrastructure, and of export promotion, to the needs of the Top Sectors.

The government notionally allocated over €1 billion (roughly NZ\$1.7 billion) a year to the Top Sectors policy in the period 2013 to 2016. Most of this was existing funding in relevant portfolios (eg, education, innovation, and foreign policy) that align with the Top Sectors approach. The Organisation for Scientific Research provides some earmarked funding. Across the Top Sectors, businesses invested a similar amount in research to public funding (Arnold et al., 2018; OECD, 2014). The Top Sector approach also attracts funding from European research and innovation programs.

### **Evaluations of the Top Sector approach**

Evaluations of the Top Sector approach have identified strengths and weaknesses (Dialogic, 2017; Janssen, 2019). Its primary goal was to enhance cooperation and alignment across businesses, research organisations and government agencies, ultimately strengthening the national innovation system. This goal has been achieved, with better alignment within the Top Sectors and across government departments, especially the Ministry for Economic Affairs and Climate Policy and the Ministry for Education, Culture and Science. Top Teams and TKIs have improved the exchange of information and cooperation and speed of collaboration between the parties. Officials have a better understanding of Top Sector problem areas and requirements, and so are better engaged with the relevant Top Sectors. In some sectors, progress has been made in relevant trade facilitation and human capital development. Demand-driven research programmes in Dutch knowledge institutes have grown.

However, the approach has some weaknesses. Top Teams work in a self-organising manner, which can reinforce existing ecosystems and the dominance of large incumbents. While Top Sector activities and networks are open to anyone active in the relevant domain, outsiders sometimes find it difficult to participate (Janssen, 2019). This impacts the novelty of activities, as the focus is on aligning business, research, education, and policy around existing innovation ambitions, rather than exchanging and realising views on new pathways. Moreover, evaluation found that the government sometimes missed opportunities to align cross-economy policies (such as innovative procurement) with the Top Sector approach.

Overall, the policy has improved networking in some sectors, but it has been less successful in promoting radical innovation. A main problem, according to Arnold (2018), was the government's "hands off" approach, which resulted in the implementation being left to industrial and research actors, failing to generate an overall national strategy or direction. This points to the absence of high-level leadership in the Netherlands innovation system, particularly from the government.

## **Mission Driven Top Sectors policy**

In 2018, the Top Sectors approach was revised and replaced by the Mission Driven Top-sectors policy. The Mission Driven Top-sectors policy aims to focus innovation on addressing societal challenges in four areas: Energy transition and sustainability, Agriculture, Water and Food, Health and Healthcare, and Security (OECD, 2018). The policy provides for the governance of 25 missions, to be implemented across the existing Top Sector organisational architecture. Each Top Sector thus works across multiple missions. In practice, the governance of the Mission Driven Top-Sectors policy is evolving as Top Sectors refine policies and their implementation to achieve the missions. It remains to be seen what kind of strengths and challenges this shift in direction will yield (Janssen, 2020).

### **2.4.3 Assessment of governance arrangements**

The Netherlands lacks a national governing body to prioritise and steer innovation effort. Instead, it relies on a well-embedded culture of networking and consensus-based policy making to do so. Each of the Top Sectors is broadly defined, and the Top Teams and Top consortia for knowledge and



innovation play a significant role in prioritising and steering innovation effort within these areas (OECD, 2014). The government has over the last five years applied a “mission-driven” lens to the Top Sector institutions and processes.

For a period, the Netherlands tried steering national innovation policy through a body somewhat modelled on the Finnish National Innovation Council. The Innovation Platform had a high level of autonomy (despite having the status of a cabinet committee) but lacked access to resources to implement change. A new government abolished it in 2010.

Evaluation of the Top Sectors show that they were successful in promoting collaboration on innovation, improved understanding among officials of barriers to innovation effort, improved the focus of trade facilitation and education and training initiatives, and led to better alignment of research in public research organisations with business innovation. The Top Sectors have been less successful in tackling strategically important challenges that require more radical innovation. The government has responded to this issue with the refreshed Mission-Driven Top Sectors policy.

## 2.5 Singapore

Singapore has developed rapidly since its independence in the 1960s to reach its current position as a high-income SAE. Its rise was built on its position as a major port, its history of industries supporting a major naval base, a strong emphasis on education, and active state involvement in supporting economic development. Manufacturing accounts for up to 25% of Singapore’s GDP with strengths in electronics, chemicals, biomedical sciences, logistics and transport engineering. These strengths are complemented by its rapid growth as a regional financial services centre.

Singapore is geographically concentrated and, though a multi-party democracy, has been governed by a single party throughout the period since independence. These factors have created strong and enduring networks across industry, government and knowledge institutions that help the formation of widely supported agendas for economic and social progress. Singapore has regularly (at five to ten-year intervals) refreshed an economic strategy that includes a focus on industry sectors.

The formation and operation of a state-owned investment company, Temasek, has been influential in Singapore’s development. It was established in 1974 to take over and operate at arm’s-length 35 businesses that had been directly owned by the Singaporean government since independence. Temasek still holds 10 of these initial companies as part of its wider portfolio. Its investment strategy has increased the value of this portfolio to S\$382 billion (NZ\$462 billion) across transport, financial services, telecommunications, real estate, and life sciences. Temasek is an active participator in Singapore’s focused innovation policy efforts.

### 2.5.1 High-level governance of innovation policy

Singapore has adopted a cluster approach to pursuing economic development, which collectively covers a large part of the economy. Most recent high-level governance of this approach is through the Future Economy Council (FEC) which leads the development of industry transformation maps (ITMs) for each cluster. The FEC was established in 2017 following the report of the Singapore Committee on the Future Economy.<sup>4</sup>

---

<sup>4</sup> In 2017 the Singapore Committee on the Future Economy, led by economic Ministers and reporting to the Prime Minister, set out an approach to economic development that included six cross-economy strategies and one focused on industry sectors. The cross-economy strategies covered international connections, skills, digital capabilities, city vibrancy and opportunity, and partnerships for innovation and growth (Singapore Committee on the Future Economy, 2017).

*The Future Economy Council drives the growth and transformation of Singapore's economy for the future. Chaired by Deputy Prime Minister & Coordinating Minister for Economic Policies, Mr. Heng Swee Keat, the Council comprises members from government, industry, trade associations and chambers, unions, and educational and training institutions.*

Ministry of Trade and Industry Singapore (2023)

The FEC currently comprises 40 representatives from the government, unions, industry and universities, selected for “extensive experience and expertise across different fields, and strong stewardship in their respective sectors” (Future Economy Council, 2021, p. 1). Some of the business and union members have past close links with the government. For example, the National Trades Union Congress Secretary-General, Mr. Ng Chee Ming, previously served as the Minister of Education (Schools) and Second Minister for Transport, and, before that, Chief of Defence Force.

In the current period of the FEC the ITMs will be more closely aligned with the RIE2025 plan (Research, Innovation and Enterprise plan developed by the National Research Foundation Singapore (NRF)) (Future Economy Council, 2021; National Research Foundation, Singapore, n.d.). The intention is to build greater synergy between research and industry transformation efforts. The ITMs will also include a significant stream of work to build workforce skills.

The NRF, an agency of the Prime Minister's Office, was established in 2010 as a successor to the National Science and Technology Board (first established in 1991 and restructured in the 2000s). Like the FEC, the Deputy Prime Minister chairs the NRF. The NRF and its predecessors have been responsible for developing science and technology plans under various names, and since 2010 (known as the five-yearly RIE plans). The current plan includes government investments in research, innovation and enterprise of around S\$25 billion (NZ\$30 billion) over five years. The plan covers four domains (Manufacturing, Trade and Connectivity; Human Health and Potential; Urban Solutions and Sustainability; and Smart nation and Digital Economy) and has a specific focus on “scal[ing] up platforms to drive technology translation and strengthen the innovation capabilities of our enterprises” (National Research Foundation, Singapore, n.d.).

The Ministry of Trade and Industry has the main oversight of focused innovation policy in Singapore. Other agencies are involved in initiatives relating to their portfolio, including the NRF, the Economic Development Board (an agency of the Ministry of Trade and Industry responsible for investment promotion), Enterprise Singapore (an agency of the Ministry of Trade and Industry responsible for small and medium businesses), the Ministry of Education (which is responsible for tertiary education), the Ministry of Health, and the Ministry of Communications and Information.

The Ministry of Trade and Industry supports the operation of the FEC. It also oversees the work of nine statutory boards (including the Economic Development Board and Enterprise Singapore). The Singapore Department of Statistics operates within the Ministry of Trade and Industry.

## **2.5.2 Devolved governance**

### **Industry Transformation Maps**

In pursuing its economic agenda, Singapore has adopted a “cluster” approach for the governance of Industry Transformation Maps. Industries are grouped to look for synergies and spillovers (for instance, in common technology supply chains or skill requirements) across related industries (Ministry of Trade and Industry Singapore, n.d.).

In 2016, the Singapore Government allocated S\$4.5 billion (NZ\$4.9 billion) to the ITM programme over a period of five years. This funding was separate to funding for research, and detailed expenditure was decided (and administered through government agencies) as the ITMs developed (Lee, 2016; Ministry of Trade and Industry Singapore, 2020b).

Subcommittees of the Future Economy Council lead the development of ITMs within the cluster approach. Each of the sub-committees is co-chaired by a government minister and a business CEO. A nominated government agency leads each cluster (including the Singapore Economic Development

Agency, the Ministry of Transport, the Ministry of Health and the Ministry of Education, the Building and Construction Authority, the Ministry of Sustainability and the Environment and the Ministry of Trade and Industry, and the Ministry of Communications and Information, and Enterprise Singapore) (Ministry of Trade and Industry Singapore, n.d.).

The sector approach intends to produce 23 ITMs, eventually covering 80% of the economy. By 2020, Singapore had developed ITMs for a range of industries, including retail, professional services, food services, hotels, precision engineering, logistics, sea transport and food manufacturing. In essence, the ITMs are a device for collaboration across industry interests (employers and workers), universities and other research and training institutions, and the government. The ITMs together will identify how the cross-economy strategies are coming together in a particular area of the economy and decide how to tackle barriers and realise opportunities (including those involving innovation and technology).

## The Emerging Stronger Taskforce and Alliances for Action

Singapore, through the Future Economy Council (FEC), used existing governance arrangements and industry-government collaborations to rapidly develop resilient responses to the economic challenges of the COVID-19 crisis. The Government set up an Emerging Stronger Taskforce (EST) in 2020 under the umbrella of the FEC to “oversee the longer-term work of responding to the structural shifts in our economy”(Ministry of Trade and Industry Singapore, 2020a).

The EST recognised six critical shifts that Singapore needed to prepare for, to build economic resilience. The shifts were global fragmentation, industry consolidation, reconfiguration of global supply chains, accelerated digital transformation, changing consumer preferences, and an increased focus on sustainability (Emerging Stronger Taskforce, 2021). The Taskforce worked closely with the FEC and its industry clusters, and consulted widely with businesses, unions and Singaporeans. The Taskforce then formed the Alliances for Action (AfAs) with key stakeholders from the public and private sectors to swiftly test and pilot ideas using an agile startup approach (Emerging Stronger Taskforce, 2021).

*...the EST identified areas of opportunity for Singapore to invest in, amidst the key shifts in our operating environment, and set off pathfinders to explore new, creative ideas that could pave the way for our broader ambitions. **The EST therefore adopted a bias to action that allowed the EST and its partners to quickly pilot and test-bed some of its initial ideas, through a collaborative approach that we term “Alliances for Action” (AfAs).***

Ministry of Trade and Industry Singapore (2020a, p. 7)

The EST identified the advantages of the Alliances for Action model as follows:

*As industry-led coalitions, working in close partnership with the Government, the AfAs translated our ambitions for Singapore into action-oriented experimentation and learning to help us advance key growth opportunities or push new frontiers... by adopting an agile “startup” approach, the AfAs were able to work quickly to prototype ideas within a short period of time, while concurrently engaging government agencies and other key stakeholders to stretch the medium- to long-term ambitions in each of these opportunity areas.*

Ministry of Trade and Industry Singapore (2020a, p. 58)

The Minister of National Development and the Group CEO of PSA International (a global logistics and ports company 100% owned by Temasek) co-chaired the EST. Of the 21 other members of the EST, 16 were business leaders, with the others from business peak bodies (three), the union movement (one), and the National University of Singapore (one).

Each of the nine Alliances for Action had a business lead or leads and between five and 13 members in total, the great majority with a business background. The Alliances for Action covered, AgriTech, Digitalising the Built Environment, EduTech, Enabling Safe and Innovative Visitor Experiences, Facilitating Smart Commerce, Med Tech, Robotics, Supply Chain Digitalisation, and Sustainability. A wider range of union, professional services and think tank organisations contributed. A secretariat and

communications and engagement team of more than 30 staff from public sector organisations supported the EST (Emerging Stronger Taskforce, 2021).

As an example of rapid progress, the Supply Chain Digitisation Alliance for Action began a pilot initiative in November 2020, which led to the Trade Data Exchange being officially launched in June 2022 (Yu, 2022). The Trade Data Exchange serves as common data infrastructure to enable businesses to optimise supply chain flows through Singapore and expand their export markets (Emerging Stronger Taskforce, 2021).

The EST noted that the Alliances for Action model was successful in:

- rallying industry around complex problems
- delivering concrete initiatives within short timelines
- achieving private-public alignment on the roadmap for scaling up
- collecting feedback and data from rapid concept testing to support business cases where indicated.

The EST proposed that, in the future, the EST should make more use of the Alliances for Action model. The FEC in its most recent renewal of its strategy (ITM 2025) signalled that it would incorporate the recommendations of the EST (Deputy Prime Minister Singapore (Heng Swee Keat), 2021).

Congruent with the EST approach (and also to facilitate better alignment with the Research, Innovation and Enterprise plan 2025) the FEC is now organising the 23 ITMs under seven broad clusters (Future Economy Council, 2021).

### **2.5.3 Assessment of governance arrangements**

High-level governance of focused innovation policy in Singapore, is highly integrated with devolved governance arrangements for the implementation of initiatives. The government participates with a wide range of business, research and higher education interests to set national direction through the Future Economy Council (FEC). Sub-committees of the FEC, again including a wide range of interests, oversee progress on the Industry Transformation Maps, closely supported by relevant government agencies. These arrangements reflect the highly networked and high-trust foundations underpinning the Singapore polity, society and economy.

Focused innovation policy in Singapore is also increasingly aligned with overall research funding policy. The Deputy Prime Minister chairs both the FEC and the National Research Foundation, and the Industry Transformation Maps are now being aligned with the Research, Innovation and Enterprise plan 2025.

Strong existing formal and informal networks enabled the Singaporean government to quickly engage with business and other interests to respond to the COVID-19 crisis through the Emerging Stronger Taskforce and Alliances for Action initiatives. Deputy Prime Minister, Heng Swee Keat (2021) observed: “We have a head start as we started our ITM effort five years ago.”

## 2.6 Canadian global innovation clusters

Canada, a larger economy than those discussed above<sup>5</sup>, has since 2017 implemented the Global Innovation Clusters (GIC)<sup>6</sup> initiative. This devolves governance and funding of focused innovation policy to business-led independent bodies, like similar programmes in Sweden and Finland discussed above. During the COVID-19 pandemic, the Canadian Government used the devolved governance arrangements to work with firms to implement supply-chain and other pandemic-related initiatives (Innovation, Science and Economic Development Canada, 2022; Knubley, 2021).

The overall aim of the GIC is to realise Canada's potential as a global leader in innovation. Motivation for the GIC arose from a recognition that standard policies for promoting innovation through tax incentives, sound macroeconomic policy, and supply-side support for science and universities were not working for Canada (Knubley, 2021).

The GIC is an experimental approach with devolved administration centred on five areas of existing technology strengths in the Canadian economy. These areas of strength often span a range of industries (Beaudry & Solar-Pelletier, 2020; Government of Canada, 2022; Knubley, 2021). The approach aims to build on the critical mass and innovation networks of existing clusters, to strengthen connections and raise global brand recognition. The global clusters draw on and intend to be a magnet for specialised inputs, including technologies, talent and infrastructure. While centred in identifiable locations, the global clusters involve business-led networks across Canada and even globally (Knubley, 2021).

The GIC has innovation and economic outcomes as its major focus. These include fostering start-ups, commercialising R&D and participation in global value chains. It aims to build connections between large and small businesses. It is not primarily focused on fundamental research but draws on the outcomes of such research in its innovation efforts.

### 2.6.1 Cluster selection

Innovation, Science and Economic Development Canada (ISED) ran a two-stage process in 2017 to select global innovation clusters from industry-led applications. In the first stage, officials from relevant agencies assessed 50 letters of intent, representing over 1,000 businesses and 350 other participants. Nine applicants were invited to submit detailed proposals from which officials and outside experts selected the five winners (Knubley, 2021). Criteria for selection included the potential contribution to innovation and competitiveness outcomes, growth in jobs and output<sup>7</sup> and planned increases in women's participation in cluster leadership and skilled work.

The five selected global innovation clusters were:

- the Digital Technology cluster based in British Columbia, with a focus on improving service delivery and efficiency in the natural resource, precision health, and manufacturing sectors
- the Protein Industries cluster based in the Prairie Provinces, including a focus on plant genomics to improve nutrition, plant-based meat alternatives, and novel processing technologies

---

<sup>5</sup> Because Canada is not a small advanced economy, and because it has a federal system of government, we do not discuss here Canadian arrangements for high-level national or provincial governance of focused innovation policy.

<sup>6</sup> When implemented the policy was known as the "innovation superclusters initiative". The Canadian government extended the policy with a further five years funding in 2022, and changed its name to the "global innovation clusters" program (Government of Canada, 2022).

<sup>7</sup> The Office of the Parliamentary Budget Officer expressed skepticism about the anticipated effects of the GIC on output and jobs (Office of the Parliamentary Budget Officer Canada, 2020). Knubley notes that the Minister responsible for launching the program chose to highlight these measures to best explain the program's benefits to the "person in the street", though the key objectives of the program was to stimulate collaborative innovation and commercialisation (Knubley, 2021, pp. 6–7).

- the Next Generation Manufacturing cluster based in Ontario, including a focus on building manufacturing capabilities through advanced robotics and 3D printing
- the Scale AI cluster based in Quebec on the Montreal-Waterloo corridor with a focus on building intelligent supply chains across the retail, manufacturing, transportation, infrastructure and ICT sectors
- the Ocean cluster, based in Atlantic Canada, covering marine renewable energy, fisheries, aquaculture, oil and gas, defence, shipbuilding, transportation and ocean technology, with a focus on improving efficiency, sustainability and safety.

## 2.6.2 Devolved governance

An independent, not-for-profit corporation, with its own board of directors, leads each of the five global clusters. Each board sets its strategy and funds projects to support this strategy. Members of the clusters include businesses, academic institutions, and not-for-profit organisations. Membership is open to new applicants, while some clusters have associated fees or different membership levels, including free options (Government of Canada, 2023a).

Setting up governance arrangements required negotiations with the Government of Canada “concerning board composition, how to flow funding, and annual reporting, focusing on accountability to taxpayers. In hindsight, there might have been more flexibility as ...clusters were set up” (Knubley, 2021, p. 9). Because the program required co-investment and involved building relationships and capacity, it took time to deliver funded innovation projects (Knubley, 2021; Office of the Parliamentary Budget Officer Canada, 2020). A shift to tackle the challenges posed by the COVID-19 pandemic also slowed approval of other cluster projects (Innovation, Science and Economic Development Canada, 2022, p. 34).

Within each cluster’s strategy, eligible projects for co-funding relate to one or more of five themes – technology leadership, partnerships for scale, diverse and skilled talent pools, global advantage, and access to innovation. The GIC program has, with some difficulty, developed a careful, nuanced approach to IP protection and IP sharing in the context of collaborative innovation projects (Innovation, Science and Economic Development Canada, 2022; Knubley, 2021).

## Funding

The Canadian Government first funded the GIC with up to C\$950 million (NZ\$1.03 billion) over five years to 2023. The Government required private-sector participants to at least match this funding with cash and in-kind (up to 25%) contributions. In practice this requirement was more than met, with private funding up to double public funding (Innovation, Science and Economic Development Canada, 2022; Knubley, 2021).

Global clusters may use government funding for administration and for specific projects. With some exceptions (because of COVID-19 initiatives) project funding is only for new initiatives (not business as usual) and is awarded to consortia rather than individual companies. All consortia must include a small or medium enterprise. In practice over 50% of project partners are small- or medium-sized firms.

The Canadian Government, in 2021, provided additional funding of C\$60 million (NZ\$73 million) to support three of the clusters to undertake COVID-19 initiatives (\$20 million each to the Digital Technology, Protein Industries, and Next Generation Manufacturing clusters). In 2022 it allocated a further C\$750 million (NZ\$912 million) to support the GIC program for another five years from 2023 (Government of Canada, 2023b).

## Global Innovation Clusters program performance

Innovation, Science and Economic Development Canada (ISED) has conducted an in-house qualitative evaluation of the GIC formally covering the period from inception in April 2017 up to 31

March 2021, but including more recent data for some analyses (Innovation, Science and Economic Development Canada, 2022). Knubley (2021) provides a more informal account of the GIC and its performance over the same period, partly based on his experience as the administrative head of ISED during the design and implementation of the program.

The ISED evaluation found that the GIC had been successful in increasing collaboration on innovation, raising technology investment, and in developing regional innovation ecosystems. The five clusters in total had over 7,000 members by 2022. Collaboration extended beyond the life of specific funded projects. Business participants in projects reported financial benefits through technology development and commercialisation, including the development of 46 new or improved products, services, or processes and through an additional C\$14 million (NZ\$ 17 million) in annual sales revenue. By March 2021, 93 projects had been launched to develop new technologies, 52 to develop ecosystems, and 74 to respond to the pandemic.

Knubley identified positive results for the GIC in terms of an ability to attract business co-investments in total more than 1.4 times greater than the government contribution, success in involving smaller firms in projects (they are more than 50% of project partners), business-led training initiatives, and better international branding of Canadian technology. There has been a tendency to support smaller, incremental innovation projects (with an average funding of C\$4.7 million, according to the ISED evaluation), rather than more transformational projects. Clusters have been slow to establish new global supply chain relationships. Large anchor firms tended to dominate the boards of GICs, requiring deliberate effort to involve smaller firms and universities and colleges. Knubley recommended that ISED commission an independent evaluation of the ISED program, including developing an evaluation framework in conjunction with the GIC secretariats.

Both ISED and Knubley emphasise that the development of innovation ecosystems and co-investment plans takes time, and evaluations of program performance need to be calibrated accordingly. Specifically, participants in the ISED evaluation emphasised that (by March 2021) it was too early to fully realise the commercialisation and related business benefits of the GICs. Each of the GICs has its own specific dynamic in terms of motivation, participant make up and shared interests, shared technologies and technology maturity. Each will perform differently and at a different pace as delivery models develop over time (Innovation, Science and Economic Development Canada, 2022). An experimental approach carried with it the possibility of some failing (Knubley, 2021).

## COVID-19 projects

Knubley and Innovation, Science and Economic Development Canada (ISED) discuss how the GICs, with additional government and business funding, pivoted to undertake COVID-19 projects. Next Generation Manufacturing was the first to do so, leading to new initiatives to manufacture pandemic-related products such as PPE, medical devices, test kits, and robotic disinfecting systems. The Protein Industries and Digital Technology clusters also undertook especially funded industry-led initiatives.

Knubley (2021) argues that the response to the COVID-19 shows how clusters can support tackling other emerging societal challenges.

*The [GICs]...support of COVID-19 projects suggests that each can pivot again, as required, and leverage its business model to deliver on short-term needs while growing the impact of other longer-term objectives. The national agenda being proposed for making the economy sustainable, green and net zero is a case in point. The ability of the [GICs] ... to pivot to address new issues is a sign of success and adaptability...Moreover, developing the work of the [GICs]... in the health sector, including manufacturing, would be a logical outcome of their pivot to help support COVID-19 management.*

(p. 14)

Formal evaluation supported Knubley's assessment.

*ISED officials pointed to the delivery model's agility and industry-led approach as a key strength in allowing the [GICs]...to effectively respond to the identified and emerging industry priorities and mobilize during the pandemic.*

Innovation, Science and Economic Development Canada (2022, p. 35)

*Although the pandemic did create delays and disruptions, the [GICs]... participation in the pandemic response generated new business models and gains for members and the ecosystem overall.*

Innovation, Science and Economic Development Canada (2022, p. 36)

## **2.6.2 Assessment of governance arrangements**

The Global Innovation Clusters (GICs) program is a well-evaluated example of devolved governance of focused innovation policy initiatives. In design, its governance arrangements are similar to the Swedish Strategic Innovation Programs and the Finnish strategic centres for science, technology and innovation (SHOKS), though with more substantial public and private funding. Some time elapsed before the initiative resulted in funding for specific innovation projects. Government agencies and the clusters took care in working through issues around intellectual property ownership and sharing, to facilitate collaboration on innovation. GICs have been extended for a further five years till 2027.

Like similar devolved arrangements for selecting and funding projects, the GICs have been successful in promoting collaboration and in developing new products and business processes, but innovations have been incremental rather than transformational.

When supply chain disruptions occurred during the COVID-19 pandemic, the three-year old initiative provided a ready-made platform on which to build Canada's response. Evaluations found that the model is flexible enough to respond to short-term challenges, while fulfilling longer-term innovation agendas.



## 3 Lessons for New Zealand

This paper has looked at the governance arrangements for focused innovation policy in five small advanced economies (SAEs) (together with an example of devolved governance from Canada). The SAEs covered perform well on measures of national innovation effort and resilience, have high incomes, and are successful exporters. They generally have decades-long experience with focused innovation policy, reinforced by both formal and informal networks linking firms with government agencies and research organisations.

In contrast, New Zealand's experience with focused innovation policy has been patchy, inconsistent and lacking in scale (NZPC, 2021, 2023). An important lesson from the SAEs covered in this paper is that focused innovation effort builds on networks and a culture of collaboration that persist in some form over time. Initiatives need to be experimental and adaptive, taking on board the outcomes of continuing evaluation. When governments change, focused innovation policies adjust but existing networks and the expectations of participants carry them forward.

More recently the SAEs covered in this paper have been adapting focused innovation policies to tackle societal challenges such as those posed by climate change. This seems to require more steering from national bodies while still relying on devolved governance to bring forth and guide "bottom-up" initiatives that tap into the knowledge and capabilities of firms and researchers close to the innovation action.

During the COVID-19 pandemic some countries (especially Denmark, Singapore and Canada) used their collaborative networks for focused innovation policy as platforms to develop rapid and resilient responses to supply chain disruptions. The relationships and culture of trust embodied in these networks contributed to the economic resilience of these countries.

### 3.1 High-level governance

Three of the SAEs covered in this paper (Finland, Sweden and Denmark) have (or have recently had) national councils to help prioritise and align overall public and private focused innovation effort. Commentators argue that such bodies are becoming more important for guiding national strategies and priorities, as countries tackle broad societal challenges. Such challenges involve many arenas of society and the economy, and potentially many actors contribute to making progress.

The Netherlands and Denmark do not have such councils. They instead rely more on informal and informal networks to build consensus on policies and priorities within the ambit of those networks. In each case, reviewers have argued a need for more deliberate setting of national priorities.

Because New Zealand's collaborative networks are less well-established and less enduring, its lack of a national body to help set priorities and align effort is arguably more salient than in the Netherlands and Denmark. New Zealand is one of the few countries in the OECD that lacks a high-level research and innovation council of any sort (Borowiecki & Paunov, 2018).

### 3.2 Devolved governance

Devolved governance of focused innovation policy in the SAEs covered in this paper takes many forms. This reflects country-specific circumstances, and different objectives, though all with the intention of building bottom-up collaboration on innovation. Each of the countries has a strong culture of evaluation of initiatives, and a commitment to using evaluations to adjust course and inform the design of new initiatives.

Evaluations of programmes with devolved governance of focused innovation policy tend to find that while successful in increasing collaboration and incremental innovation outcomes to boost economic performance, they are less successful in promoting transformational innovation. As noted above, some reviewers argue that national bodies need to take a stronger role in prioritising and steering

initiatives to achieve more transformational outcomes. Singapore, with its close integration of high-level and devolved governance of innovation policy, appears to have managed this tension well.

Another lesson from evaluations, is that it takes time for devolved governance arrangements to mature and result in well-designed innovation projects. Stop-start approaches to policy are likely to be counter-productive in making progress.

# References

- Advisory council for science, technology and innovation. (2021, May 4). *About us* [Home page]. Ministerie van Onderwijs Cultuur en Wetenschap. [www.awti.nl/english](http://www.awti.nl/english)
- Ali-Yrkkö, J., Hume, A. R., Cherif, R., Hasanov, F., Kuosmanen, N., & Pajarinen, M. (2021). *Knowledge Spillovers From Superstar Tech-Firms: The Case of Nokia* (IMF Working Paper WP/21/258). International Monetary Fund. [www.elibrary.imf.org/view/journals/001/2021/258/article-A001-en.xml](http://www.elibrary.imf.org/view/journals/001/2021/258/article-A001-en.xml)
- Arnold, E., Åström, T., Glass, C., & De Scalzi, M. (2018). *How should we evaluate complex programmes for innovation and socio-technical transitions?* Technopolis Group. [www.technopolis-group.com/wp-content/uploads/2020/02/How-should-we-evaluate-complex-programmes-for-innovation-and-socio-technical-transitions.pdf](http://www.technopolis-group.com/wp-content/uploads/2020/02/How-should-we-evaluate-complex-programmes-for-innovation-and-socio-technical-transitions.pdf)
- Arnold, E., Warta, K., Halme, K., Evers, G., Haila, K., Järvelin, A.-M., Kettinen, J., Kolarz, P., Piirainen, K., & Sutinen, L. (2022). *Evaluation of the Academy of Finland*. Ministry of Education and Culture, Finland. [https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163881/OKM\\_2022\\_7.pdf?sequence=1&isAllowed=y#:~:text=Overall%20conclusion%20is%20that%20the,to%20make%20a%20fuller%20contribution](https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163881/OKM_2022_7.pdf?sequence=1&isAllowed=y#:~:text=Overall%20conclusion%20is%20that%20the,to%20make%20a%20fuller%20contribution)
- Åström, T., Arnold, E., & Olsson, J. (2021). *Meta-evaluation of the third round of strategic innovation programmes after six years*. Technopolis Group. [www.technopolis-group.com/report/evaluating-the-17-strategic-innovation-programmes-sips/](http://www.technopolis-group.com/report/evaluating-the-17-strategic-innovation-programmes-sips/)
- Beaudry, C., & Solar-Pelletier, L. (2020). *The superclusters initiative: An opportunity to reinforce innovation ecosystems* [IRPP Study 79]. Institute for Research on Public Policy. <https://irpp.org/wp-content/uploads/2020/10/The-Superclusters-Initiative-An-Opportunity-to-Reinforce-Innovation-Ecosystems.pdf>
- Berg, M., & Bruland, K. (Eds.). (1998). *Technological revolutions in Europe: Historical perspectives*. Edward Elgar Publishing. [www.worldcat.org/title/technological-revolutions-in-europe-historical-perspectives/oclc/37993790](http://www.worldcat.org/title/technological-revolutions-in-europe-historical-perspectives/oclc/37993790)
- Borowiecki, M., & Paunov, C. (2018). *How is research policy across the OECD organised?: Insights from a new policy database* (OECD Science, Technology and Industry Policy Papers 2018/55). OECD. [www.researchgate.net/profile/Caroline-Paunov/publication/328145081\\_How\\_is\\_research\\_policy\\_across\\_the\\_OECD\\_organised\\_Insights\\_from\\_a\\_new\\_policy\\_database/links/5ca7007aa6fdcca26dfee960/How-is-research-policy-across-the-OECD-organised-Insights-from-a-new-policy-database.pdf](http://www.researchgate.net/profile/Caroline-Paunov/publication/328145081_How_is_research_policy_across_the_OECD_organised_Insights_from_a_new_policy_database/links/5ca7007aa6fdcca26dfee960/How-is-research-policy-across-the-OECD-organised-Insights-from-a-new-policy-database.pdf)
- Business Finland. (n.d.-a). *Bionets—Business of the future*. Business Finland. Retrieved 21 November 2023, from [www.businessfinland.fi/en/for-finnish-customers/services/programs/ended-programs/bionets](http://www.businessfinland.fi/en/for-finnish-customers/services/programs/ended-programs/bionets)
- Business Finland. (2022). *Results and impact 2022*. Business Finland. [www.businessfinland.fi/492bd8/globalassets/finnish-customers/about-us/results-and-impact/tulokset-ja-vaikutukset-2023-en.pdf](http://www.businessfinland.fi/492bd8/globalassets/finnish-customers/about-us/results-and-impact/tulokset-ja-vaikutukset-2023-en.pdf)
- Business Finland. (n.d.b). *Growth engines funding for forerunners of a market disruption*. Business Finland. [www.businessfinland.fi/en/for-finnish-customers/services/funding/growth-engines](http://www.businessfinland.fi/en/for-finnish-customers/services/funding/growth-engines)
- BusinessOulu. (n.d.). *Oulu Innovation Alliance*. Oulu. Retrieved 6 November 2023, from <https://oulu.com/en/oia/>
- Chang, H.-J. (2002). *Kicking away the ladder: Development strategy in historical perspective*. Anthem Press. [www.researchgate.net/publication/200465485\\_Kicking\\_Away\\_the\\_Ladder\\_Development\\_Strategy\\_in\\_Historical\\_Perspective](http://www.researchgate.net/publication/200465485_Kicking_Away_the_Ladder_Development_Strategy_in_Historical_Perspective)

- Chatzopoulou, S., & Karantininis, K. (2022). Resilience and adaptability capacity in the Danish agriculture and food system: Continuity and change. In A. Hagedorn Krogh, A. Agger, & P. Triantafyllou (Eds.), *Public Governance in Denmark* (pp. 169–188). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-80043-712-820221010>
- Christensen, J. L., & Knudsen, M. P. (2021). The performance, challenges and related policies of the Danish research and innovation system. In J. L. Christensen, B. Gregersen, J. R. Holm, & E. Lorenz (Eds.), *Globalisation, New and Emerging Technologies, and Sustainable Development: The Danish Innovation System in Transition* (pp. 33–52). <https://doi.org/10.4324/9781003037750-4>
- Cluster Excellence Denmark. (n.d.-a). *Cluster history*. Retrieved 16 November 2023, from <https://clusterexcellencedenmark.dk/the-danish-clusters/cluster-history/?lang=en>
- Cluster Excellence Denmark. (n.d.-b). *The Danish clusters: Denmark's 13 national clusters* [Home page]. <https://clusterexcellencedenmark.dk/the-danish-clusters/denmarks-13-national-clusters/?lang=en>
- Crawford, R. (2021). *Focused innovation policy: Lessons from international experience* (Working Paper 2021/03). New Zealand Productivity Commission. [www.productivity.govt.nz/assets/Documents/focused-innovation-policy/Focused-innovation-policy.pdf](http://www.productivity.govt.nz/assets/Documents/focused-innovation-policy/Focused-innovation-policy.pdf)
- Danish Council for Research and Innovation Policy. (2023, September). *The Danish Council for Research and Innovation Policy* [Home page]. Ministry of Higher Education and Science. <https://ufm.dk/en/research-and-innovation/councils-and-commissions/the-danish-council-for-research-and-innovation-policy>
- Deputy Prime Minister Singapore (Heng Swee Keat). (2021, April 30). *Remarks by Deputy Prime Minister, coordinating Minister for economic policies, Minister for Finance and Chairman of Future Economy Council Heng Swee Keat* [Microsite News Article]. Ministry of Trade and Industry Singapore. [www.mti.gov.sg/FutureEconomy/TheFutureEconomyCouncil/Press-Releases/Articles/General/2021/Remarks-by-Deputy-Prime-Minister-for-the-FEC-Meeting](http://www.mti.gov.sg/FutureEconomy/TheFutureEconomyCouncil/Press-Releases/Articles/General/2021/Remarks-by-Deputy-Prime-Minister-for-the-FEC-Meeting)
- Deschryvere, M., Husso, K., & Suominen, A. (2021). *Targeting R&D intensity in Finnish innovation policy* (OECD Science, Technology and Industry Working Papers 2021/08). Directorate for Science, Technology and Innovation, OECD. [www.researchgate.net/profile/Matthias-Deschryvere-2/publication/353878754\\_Targeting\\_RD\\_intensity\\_in\\_Finnish\\_innovation\\_policy/links/611620db0c2bf2a282a3f6817/Targeting-R-D-intensity-in-Finnish-innovation-policy.pdf](http://www.researchgate.net/profile/Matthias-Deschryvere-2/publication/353878754_Targeting_RD_intensity_in_Finnish_innovation_policy/links/611620db0c2bf2a282a3f6817/Targeting-R-D-intensity-in-Finnish-innovation-policy.pdf)
- Dialogic. (2017). *Topsector approach management summary* [Evaluation]. [www.dialogic.nl/wp-content/uploads/2017/08/Evaluation-Topsector-Approach-Management-Summary.pdf](http://www.dialogic.nl/wp-content/uploads/2017/08/Evaluation-Topsector-Approach-Management-Summary.pdf)
- DIMECC. (2020). *Welcome to the open DIMECC hightech ecosystem* [Home page]. [www.dimecc.com](http://www.dimecc.com)
- Easterly, W. R. (2002). *The elusive quest for growth: Economists' adventures and misadventures in the tropics*. MIT press. <https://mitpress.mit.edu/9780262550420/the-elusive-quest-for-growth/>
- Eaton, D., Tynkkynen, O., Berninger, K., Perrels, A., Romanainen, J., Vingre, A., Tiusanen, M., & Becker, D. (2021). *Business Finland advancing cleantech and bioeconomy—Evaluation of three innovation and six export promotion programs* (Program Evaluation Report Report 5/2021). Business Finland. [www.businessfinland.fi/4a5d5e/globalassets/julkaisut/Business-Finland-Advancing-Cleantech-and-Bioeconomy-5-2021.pdf](http://www.businessfinland.fi/4a5d5e/globalassets/julkaisut/Business-Finland-Advancing-Cleantech-and-Bioeconomy-5-2021.pdf)
- Edquist, C. (2019). Towards a holistic innovation policy: Can the Swedish National Innovation Council (NIC) be a role model? *Research Policy*, 48(4), 869–879. <https://doi.org/10.1016/j.respol.2018.10.008>
- Emerging Stronger Taskforce. (2021). *Emerging Stronger Taskforce report*. [www.mti.gov.sg/-/media/MTI/Microsites/FEC/Afas-reports/EST-Report\\_Single-Page.pdf](http://www.mti.gov.sg/-/media/MTI/Microsites/FEC/Afas-reports/EST-Report_Single-Page.pdf)
- European Cluster Collaboration Platform. (2021). *Developing EU cluster capacities to manage shocks*. <https://clustercollaboration.eu/sites/default/files/2022-01/EU-cluster-capacities-to-manage-shocks.pdf>

European Commission. (2023). *European innovation scoreboard*. [https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard\\_en](https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en)

European Union. (2009). *The Lund Declaration*. Swedish Research Council. [www.vr.se/download/18.3936818b16e6f40bd3e5cd/1574173799722/Lund%20Declaration%202009.pdf](http://www.vr.se/download/18.3936818b16e6f40bd3e5cd/1574173799722/Lund%20Declaration%202009.pdf)

Export and Investment Fund of Denmark. (n.d.). *EIFO's legal basis* [About us]. Retrieved 20 November 2023, from <https://eifo.dk/en/about/legal-basis/>

Fagerberg, J., & Hutschenreiter, G. (2020). Coping with societal challenges: Lessons for innovation policy governance. *Journal of Industry, Competition and Trade*, 20, 279–305. <https://doi.org/10.4337/9781785360862>

Finnish Forest Cluster Research Strategy. (2010). *The world's leading forest cluster 2030*. Finnish Forest Cluster Research Strategy. [www.metsateollisuus.fi/uploads/2017/03/30041804/890.pdf](http://www.metsateollisuus.fi/uploads/2017/03/30041804/890.pdf)

Finnish Government. (2023). *A strong and committed Finland: Programme of Prime Minister Petteri Orpo's Government*. <https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/165044/Programme-of-Prime-Minister-Petteri-Orpos-Government-20062023.pdf?sequence=4>

Food & Bio Cluster Denmark. (n.d.). *Food & Bio Cluster Denmark* [Home page]. [www.foodbiocluster.dk/](http://www.foodbiocluster.dk/)

Foodvalley. (n.d.). *Shaping the future of food together*. Foodvalley. <https://foodvalley.nl/en/>

Forskningsfinansieringsutredningen (Research Funding Inquiry). (2023). *Ny myndighetsstruktur för finansiering av forskning och innovation (New agency structure for funding research and innovation)* [Final Report of Research Funding Inquiry]. Swedish Government. <https://doi.org/10/sou-202359/>

Fridholm, T., & Hjorth, M. H. (2022). *Nine-year evaluation of strategic innovation program: Conclusions from five evaluations in 2022*. Vinnova – Sveriges Innovationsmyndighet. [www.vinnova.se/contentassets/31903965211746d7a3e9ca658fc51051/sip9-nioarsutvardering-av-strategiska-innovationsprogram-2022.pdf?cb=20221214130603](http://www.vinnova.se/contentassets/31903965211746d7a3e9ca658fc51051/sip9-nioarsutvardering-av-strategiska-innovationsprogram-2022.pdf?cb=20221214130603)

Future Economy Council. (2021, April 30). *Future Economy Council (FEC) welcomes new members, embarks on ITM 2025 to refresh ITMs and develop new strategies for a post-Covid-19 world* [Press release]. Ministry of Trade and Industry Singapore. [www.mti.gov.sg/FutureEconomy/TheFutureEconomyCouncil/Press-Releases/Articles/General/2021/FEC-Economy-Council-Welcomes-New-Members](http://www.mti.gov.sg/FutureEconomy/TheFutureEconomyCouncil/Press-Releases/Articles/General/2021/FEC-Economy-Council-Welcomes-New-Members)

Galt, M., & Nees, C. (2022). *New Zealand's wellbeing: Is it sustainable and what are the risks?* [Background paper to Te Tai Waiora: Wellbeing in Aotearoa New Zealand 2022]. The Treasury. [www.treasury.govt.nz/sites/default/files/2022-10/tp-new-zealands-wellbeing-sustainable-what-are-risks.pdf](http://www.treasury.govt.nz/sites/default/files/2022-10/tp-new-zealands-wellbeing-sustainable-what-are-risks.pdf)

Gluckman, P., Spoonley, P., Bardsley, A., Poulton, R., Royal, T. A. C., Sridhar, H., & Clyne, D. (2023). *Addressing the challenges to social cohesion*. Kōi Tū: The Centre for Informed Futures. <https://informedfutures.org/wp-content/uploads/pdf/Addressing-the-challenges-to-social-cohesion.pdf>

Government of Canada. (2022). *2022 Budget: A plan to grow our economy and make life more affordable*. Government of Canada. [www.budget.canada.ca/2022/home-accueil-en.html](http://www.budget.canada.ca/2022/home-accueil-en.html)

Government of Canada. (2023a). *Global innovation clusters—Canadian partnerships, worldwide impacts*. Government of Canada - Canada.ca. [www.ic.gc.ca/eic/site/093.nsf/eng/home](http://www.ic.gc.ca/eic/site/093.nsf/eng/home)

Government of Canada. (2023b, February 13). *Government of Canada announces renewed funding for the Global Innovation Clusters* [Release]. [www.canada.ca/en/innovation-science-economic-development/news/2023/02/government-of-canada-announces-renewed-funding-for-the-global-innovation-clusters.html](http://www.canada.ca/en/innovation-science-economic-development/news/2023/02/government-of-canada-announces-renewed-funding-for-the-global-innovation-clusters.html)

- Independent Experts Panel. (2019). *Peer review of the Danish R&I system—Ten steps, and a leap forward: Taking Danish innovation to the next level*. European Commission. <https://op.europa.eu/s/otcD>
- Innovation Fund Denmark. (n.d.). *About Innovation Fund Denmark*. Retrieved 1 December 2023, from <https://innovationsfonden.dk/en/about-innovation-fund-denmark>
- Innovation Fund Denmark. (2021). *Innovation Fund Denmark—Strategy 2025*. Innovation Fund Denmark. [https://innovationsfonden.dk/sites/default/files/2021-01/IFD\\_strategy2025\\_ENG.pdf](https://innovationsfonden.dk/sites/default/files/2021-01/IFD_strategy2025_ENG.pdf)
- Innovation Fund Denmark. (2023a). *Guidelines Innomission: Guidelines of September 20, 2023 for the Innomission programme*. Innovation Fund Denmark. <https://innovationsfonden.dk/sites/default/files/2023-09/Guidelines%20Innomission%202023.pdf>
- Innovation Fund Denmark. (2023b). *Innomissions*. <https://innovationsfonden.dk/da/p/innomissions>
- Innovation Fund Denmark. (2023c, November). *Agreement on research reserve country: Innovation Fund Denmark will implement DKK 1.7 billion in 2024* [Release]. <https://innovationsfonden.dk/da/news-article/aftale-om-forskningsreserve-landet>
- Innovation, Science and Economic Development Canada. (2022). *Evaluation of Innovation, Science and Economic Development (ISED) Canada's Innovation Superclusters Initiative (ISI)*. Government of Canada. [https://ised-isde.canada.ca/site/audits-evaluations/sites/default/files/documents/2022-07/ISI\\_Evaluation\\_Report-2022-EN.pdf](https://ised-isde.canada.ca/site/audits-evaluations/sites/default/files/documents/2022-07/ISI_Evaluation_Report-2022-EN.pdf)
- Innovayt. (2023). *Denmark's export and investment fund*. <https://innovayt.eu/funding/eifo/>
- Janssen, M. (2019). What bangs for your buck? Assessing the design and impact of Dutch transformative policy. *Technological Forecasting and Social Change*, 138, 78–94. <https://doi.org/10.1016/j.techfore.2018.08.011>
- Janssen, M. (2020). *Post-commencement analysis of the Dutch 'Mission-oriented Topsector and Innovation Policy' strategy*. Utrecht University. [www.uu.nl/sites/default/files/Post-commencement%20analysis%20of%20the%20Dutch%20Mission-oriented%20Topsector%20and%20Innovation%20Policy.pdf](http://www.uu.nl/sites/default/files/Post-commencement%20analysis%20of%20the%20Dutch%20Mission-oriented%20Topsector%20and%20Innovation%20Policy.pdf)
- Kamp, B., Porsch, L., Wilson, J., & Hausemer, P. (2020). *Responding to COVID19: The role of clusters in supply chain adjustments* (European Cluster Collaboration Platform Discussion Paper 2). European Commission. [https://clustercollaboration.eu/sites/default/files/news\\_attachment/dp2\\_supply\\_chains\\_final.pdf](https://clustercollaboration.eu/sites/default/files/news_attachment/dp2_supply_chains_final.pdf)
- Kangas, O., & Karonen, E. (2023). Creative destruction: Consequences of the collapse of Nokia Phones in Oulu. In P. R. A. Oeji, V. Kirov, & E. Pomares (Eds.), *The practical side of digital transformation: A tool book for practitioners* (pp. 115–127). Bulgarian Academy of Sciences. [www.researchgate.net/profile/Peter-Oeij/publication/371225571\\_THE\\_PRACTICAL\\_SIDE\\_OF\\_DIGITAL\\_TRANSFORMATION\\_A\\_TOOL\\_BOOK\\_FOR\\_PRACTITIONERS/links/64797e7c79a7223765079ef6/THE-PRACTICAL-SIDE-OF-DIGITAL-TRANSFORMATION-A-TOOL-BOOK-FOR-PRACTITIONERS.pdf#page=116](http://www.researchgate.net/profile/Peter-Oeij/publication/371225571_THE_PRACTICAL_SIDE_OF_DIGITAL_TRANSFORMATION_A_TOOL_BOOK_FOR_PRACTITIONERS/links/64797e7c79a7223765079ef6/THE-PRACTICAL-SIDE-OF-DIGITAL-TRANSFORMATION-A-TOOL-BOOK-FOR-PRACTITIONERS.pdf#page=116)
- Kaye-Blake, W. (2023). Resilience is a meaningful, measurable trait of communities. *New Zealand Economic Papers*, 57(2), 133–138. <https://doi.org/10.1080/00779954.2022.2154253>
- Knubley, J. (2021). *Building superclusters for Canada*. Brookfield Institute for Innovation+ Entrepreneurship. <https://clustercollaboration.eu/sites/default/files/document-store/Building%20Superclusters%20for%20Canada%20report.pdf>
- Lähteenmäki-Smith, K., Halme, K., Lemola, T., Piirainen, K., Viljamaa, K., Haila, K., Kotiranta, A., Mari, H., Tuomas, R., & Polt, W. (2013). *'Licence to SHOK?'-External evaluation of the Strategic Centres for Science, Technology and Innovation*. Ministry of Employment, Innovation and the Economy, Finland. <https://repository.fteval.at/102/1/Licence%20to%20SHOK.pdf>

- Larrue, P. (2022). *Do mission-oriented policies for net-zero deliver on their many promises? Lessons for tackling complex and systemic societal challenges* [Issue note]. OECD Science and Technology Policy Division. [www.oecd.org/greengrowth/2022GGSD-IssueNote1-mission-oriented-policies.pdf](http://www.oecd.org/greengrowth/2022GGSD-IssueNote1-mission-oriented-policies.pdf)
- Lee, U. (2016, March 24). *Budget 2016: S\$4.5 billion set aside for industry transformation programme*. The Business Times. [www.businesstimes.com.sg/government-economy/singapore-budget-2016/budget-2016-s45-billion-set-aside-for-industry](http://www.businesstimes.com.sg/government-economy/singapore-budget-2016/budget-2016-s45-billion-set-aside-for-industry)
- Levin, P. (2009). The Swedish Model of public administration: Separation of powers -The Swedish style. *Journal of Administration and Governance*, 4(1), 38–46.
- Lysgaard, C. (2020). *Rethinking Innovation: Danish Clusters' response to the COVID-19 crisis*. [https://clustercollaboration.eu/sites/default/files/news\\_attachment/rethinking\\_innovation\\_-\\_danish\\_clusters\\_response\\_to\\_the\\_covid-19\\_crisis.pdf](https://clustercollaboration.eu/sites/default/files/news_attachment/rethinking_innovation_-_danish_clusters_response_to_the_covid-19_crisis.pdf)
- Martin, R., & Sunley, P. (2020). Regional economic resilience: Evolution and evaluation. In *Handbook on regional economic resilience* (G. Bristow&Adrian Healy, pp. 10–35). Edward Elgar Publishing. <https://doi.org/10.4337/9781785360862>
- Ministry of Business, Innovation & Employment. (2019). *New Zealand's research, science and innovation strategy* [Draft for consultation]. [www.mbie.govt.nz/dmsdocument/6935-new-zealands-research-science-and-innovation-strategy-draft-for-consultation](http://www.mbie.govt.nz/dmsdocument/6935-new-zealands-research-science-and-innovation-strategy-draft-for-consultation)
- Ministry of Education and Culture Finland. (2020). *Solutions for a sustainable and developing society: Objectives and targets of the National Roadmap for Research, Development and Innovation: A new beginning for RDI cooperation between companies and research organisation*. Ministry of Education and Culture Finland. <https://okm.fi/documents/1410845/22508665/The+National+Roadmap+for+Research,+Development+and+Innovation/e9566011-2acc-35b2-7b45-279387991430/The+National+Roadmap+for+Research,+Development+and+Innovation.pdf?t=1590136969000>
- Ministry of Education and Culture Finland. (2021). *Updated national roadmap for research development and innovation, 2021*. <https://okm.fi/en/rdi-roadmap>
- Ministry of Higher Education and Science. (2023). *Danish clusters for knowledge and business 2021-2024*. <https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/collaboration-between-research-and-industry/national-clusters>
- Ministry of Trade and Industry Singapore. (n.d.). *Economic clusters*. Retrieved 2 October 2023, from [www.mti.gov.sg/FutureEconomy/Economic-Clusters](http://www.mti.gov.sg/FutureEconomy/Economic-Clusters)
- Ministry of Trade and Industry Singapore. (2020a). *Emerging Stronger Taskforce*. [www.mti.gov.sg/FutureEconomy/Emerging-Stronger-Taskforce/](http://www.mti.gov.sg/FutureEconomy/Emerging-Stronger-Taskforce/)
- Ministry of Trade and Industry Singapore. (2020b). *Transforming industries*. [www.mti.gov.sg/Transforming-Industries/For-Industries](http://www.mti.gov.sg/Transforming-Industries/For-Industries)
- Ministry of Trade and Industry Singapore. (2023). *The Future Economy Council*. [www.mti.gov.sg/FutureEconomy/TheFutureEconomyCouncil](http://www.mti.gov.sg/FutureEconomy/TheFutureEconomyCouncil)
- National Research Foundation, Singapore. (n.d.). *RIE ecosystem*. NRF Singapore. Retrieved 2 October 2023, from [www.nrf.gov.sg/rie-ecosystem/ecosystem/](http://www.nrf.gov.sg/rie-ecosystem/ecosystem/)
- Novo Nordisk. (2014). *Invitation to growth – A road to job creation*. [www.novonordisk.com/content/dam/Denmark/HQ/media/documents/Invitation-to-growth-2014\\_UK.pdf](http://www.novonordisk.com/content/dam/Denmark/HQ/media/documents/Invitation-to-growth-2014_UK.pdf)
- Novo Nordisk Foundation. (2020). *Novo Nordisk Fonden*. <https://novonordiskfonden.dk/en>
- Novo Nordisk Foundation. (2022). *Improving the lives of people and the sustainability of society and the planet* [Annual Report]. <https://novonordiskfonden.dk/app/uploads/Novo-Nordisk-Foundation-Annual-Report-2022.pdf>

- NZPC. (2021). *New Zealand firms: Reaching for the frontier* [Final Report]. [www.productivity.govt.nz/inquiries/frontier-firms/](http://www.productivity.govt.nz/inquiries/frontier-firms/)
- NZPC. (2023). *Frontier Firms follow-on review: Detailed observations*. [www.productivity.govt.nz/inquiries/follow-on-review-frontier-firms/](http://www.productivity.govt.nz/inquiries/follow-on-review-frontier-firms/)
- OECD. (2013). *OECD reviews of innovation policy: Sweden 2012*. OECD Publishing. <http://dx.doi.org/10.1787/9789264184893-en>
- OECD. (2014). *OECD reviews of innovation policy: Netherlands 2014*. OECD Publishing. <http://dx.doi.org/10.1787/9789264213159-en>
- OECD. (2016). *OECD reviews of innovation policy: Sweden 2016*. OECD Publishing. <https://doi.org/10.1787/9789264250000-en>
- OECD. (2017). *OECD reviews of innovation policy: Finland 2017*. OECD Publishing. <http://dx.doi.org/10.1787/9789264276369-en>
- OECD. (2018). *Mission driven top-sector policy*. STIP Compass. <https://stip.oecd.org/moip/case-studies/3>
- OECD. (2019). *OECD Economic Surveys: Denmark 2019*. OECD Publishing. [https://doi.org/10.1787/eco\\_surveys-dnk-2019-en](https://doi.org/10.1787/eco_surveys-dnk-2019-en)
- OECD. (2020a). *Enterprise policy—“To the top” (topsectors)*. STIP Compass. <https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F5019>
- OECD. (2020b). *Strategic Innovation Programmes | STIP Compass*. <https://stip.oecd.org/moip/case-studies/11>
- OECD. (2022a). *OECD Economic Surveys: Finland 2022*. OECD Publishing. <https://doi.org/10.1787/516252a7-en>
- OECD. (2022b). *Promoting start-ups and scale-ups in Denmark’s sector strongholds and emerging industries*. OECD Publishing. <https://doi.org/10.1787/8f9bd7b0-en>
- OECD. (2023). *Public research funding in Sweden: Optimising the system in response to multiple demands* (OECD Science, Technology and Industry Policy Papers No. 148). OECD Publishing. <https://doi.org/10.1787/23074957>
- Office of the Parliamentary Budget Officer Canada. (2020). *The Innovation Supercluster Initiative—A preliminary analysis*. Government of Canada. <https://distribution-a617274656661637473.pbo-dpb.ca/9c165aec3e43981cb5818d0a86629b0fcfd079e95d4bdec268c2bc9512e2ac>
- Palmberg, C., & Schwaag Serger, S. (2017). *Towards next generation PPP models – Insights from an agency perspective*. Ministry of Economic Affairs and Employment of Finland. [https://tem.fi/documents/1410877/4430406/Christopher\\_Palmberg\\_Sylvia\\_Schwaag\\_Serger.pdf/9ef8f59-0519-4ea0-a270-6e09d7908ef4/Christopher\\_Palmberg\\_Sylvia\\_Schwaag\\_Serger.pdf.pdf](https://tem.fi/documents/1410877/4430406/Christopher_Palmberg_Sylvia_Schwaag_Serger.pdf/9ef8f59-0519-4ea0-a270-6e09d7908ef4/Christopher_Palmberg_Sylvia_Schwaag_Serger.pdf.pdf)
- Parliamentary RDI Working Group 2022. (2023). *Multi-annual plan for the use of research and development funding* [Final Report]. Finnish Government. [https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/165008/VN\\_2023\\_56.pdf?sequence=4&isAllowed=y](https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/165008/VN_2023_56.pdf?sequence=4&isAllowed=y)
- Paunov, C., & Borowiecki, M. (2018). The governance of public research policy across OECD countries. In *OECD Technology and Innovation Outlook 2018—Adapting to technological and societal disruption* (pp. 205–209). OECD Publishing. [https://doi.org/10.1787/sti\\_in\\_outlook-2018-en](https://doi.org/10.1787/sti_in_outlook-2018-en)
- Petridou, E. (2020). Politics and administration in times of crisis: Explaining the Swedish response to the COVID-19 crisis. *European Policy Analysis*, 6(2), 147–158. <https://doi.org/10.1002/epa2.1095>
- Piirainen, K., Halme, K., Järvelin, A.-M., Fängström, T., Engblom, H., Mensink, A., & Åström, T. (2019). *The big three—Impact study of research organisations, large enterprises and SHOKs*



- (Business Finland Report 4/2019). Business Finland.  
[www.businessfinland.fi/49a47d/globalassets/julkaisut/the\\_big\\_three\\_4\\_2019.pdf](http://www.businessfinland.fi/49a47d/globalassets/julkaisut/the_big_three_4_2019.pdf)
- Ramboll Management Consulting. (2022). *Analysis of the program Utmaningsdriven Innovation*.  
[www.vinnova.se/contentassets/6a103d9bcc1345f98ee91edef352aa40/cdi-programme-analysis-final-report-220211.pdf?cb=20220603140530](http://www.vinnova.se/contentassets/6a103d9bcc1345f98ee91edef352aa40/cdi-programme-analysis-final-report-220211.pdf?cb=20220603140530)
- Research and Innovation Council Finland. (2017). *Vision and road map of the Research and Innovation Council Finland*.  
[https://valtioneuvosto.fi/documents/10184/4102579/Vision\\_and\\_roadmap\\_RIC.pdf/195ec1c2-6ff8-4027-9d16-d561dba33450/Vision\\_and\\_roadmap\\_RIC.pdf](https://valtioneuvosto.fi/documents/10184/4102579/Vision_and_roadmap_RIC.pdf/195ec1c2-6ff8-4027-9d16-d561dba33450/Vision_and_roadmap_RIC.pdf)
- Ridley, M. (2020). *How innovation works and why it flourishes in freedom*. HarperCollins.  
[www.amazon.com/How-Innovation-Works-Flourishes-Freedom/dp/0062916599](http://www.amazon.com/How-Innovation-Works-Flourishes-Freedom/dp/0062916599)
- Rodrik, D. (2004). *Industrial policy for the twenty-first century* (Working Paper RWP04-047). Harvard Kennedy School. <https://drodrik.scholar.harvard.edu/publications/industrial-policy-twenty-first-century>
- Saarloos, W., & Dijck, J. (2017). *The Dutch Polder Model in science and research*. Amsterdam University Press. <https://doi.org/10.5117/9789462988163>
- Schwaag Serger, S., Dachs, B., Kivimaa, P., Lazarevic, D., Lukkarinen, J., Stenberg, L., & Weber, M. (2023). *Transformative innovation policy in practice in Austria, Finland and Sweden: What do the Recovery and Resilience Plans tell us about linking transformation and innovation policy?* (OECD Science, Technology and Industry Policy Papers No. 156). [www.oecd-ilibrary.org/science-and-technology/transformation-innovation-policy-in-practice-in-austria-finland-and-sweden\\_45d3a149-en](http://www.oecd-ilibrary.org/science-and-technology/transformation-innovation-policy-in-practice-in-austria-finland-and-sweden_45d3a149-en)
- Schwaag Serger, S., & Palmberg, C. (2022). Towards transformative policy in Finland and Sweden: Some viewpoints from practice. In *Smart Policies for Societies in Transition* (pp. 143–188). Edward Elgar Publishing. [www.elgaronline.com/edcollchap-0a/book/9781788970815/book-part-9781788970815-12.xml](http://www.elgaronline.com/edcollchap-0a/book/9781788970815/book-part-9781788970815-12.xml)
- Schwaag Serger, S., Wise, E., & Arnold, E. (2015). *National Research and Innovation Councils as an instrument of innovation governance—Characteristics and challenges*. Swedish Governmental Agency for Innovation Systems.  
[www.vinnova.se/contentassets/4da13cc174a448d1a3f0b816c6b74366/va\\_15\\_07t.pdf](http://www.vinnova.se/contentassets/4da13cc174a448d1a3f0b816c6b74366/va_15_07t.pdf)
- Skilling, D. (2020). *Frontier firms: An international small advanced economy perspective*. New Zealand Productivity Commission. [www.productivity.govt.nz/inquiries/frontier-firms/](http://www.productivity.govt.nz/inquiries/frontier-firms/)
- Tesi. (n.d.). *Creating new, global Finnish success stories – market change we are striving for* [About us]. Tesi. Retrieved 15 November 2023, from <https://tesi.fi/en/about-tesi/>
- The Treasury. (2021). *The Living Standards Framework 2021*.  
[www.treasury.govt.nz/sites/default/files/2021-10/tp-living-standards-framework-2021.pdf](http://www.treasury.govt.nz/sites/default/files/2021-10/tp-living-standards-framework-2021.pdf)
- Thormann, K. (2017). *The Disruption Council—A partnership for the future of Denmark*.  
[www.fafo.no/images/pub/lysark/170522\\_karen\\_thormann.pdf](http://www.fafo.no/images/pub/lysark/170522_karen_thormann.pdf)
- Upton, B. (2023, July 17). *Autonomy concerns as Sweden consolidates research funders*. Times Higher Education. [www.timeshighereducation.com/news/autonomy-concerns-sweden-consolidates-research-funders](http://www.timeshighereducation.com/news/autonomy-concerns-sweden-consolidates-research-funders)
- van der Wiel, H., & van der Kroon, H. (2014). *The policy of the Dutch government on top sectors* (pp. 29–48) [Chapter in report on Entrepreneurship in the Netherlands]. Ministry of Economic Affairs, the Netherlands.
- Vinnova. (2020, December 16). *Strategic innovation programs important for Sweden* [Press release]. Vinnova. [www.vinnova.se/en/news/2020/12/strategic-innovation-programs-important-for-sweden/](http://www.vinnova.se/en/news/2020/12/strategic-innovation-programs-important-for-sweden/)
- Vinnova. (2023). *Acceleration towards a sustainable future*. Vinnova.  
<https://www.vinnova.se/en/publikationer/acceleration-towards-a-sustainable-future/>

Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework. *Research Policy*, 41(6), 1037–1047.  
<https://doi.org/10.1016/j.respol.2011.10.015>

Weber, S. C., Schüpbach, J., Stoll, C., & Zumbühl, P. (2023). *Small countries: The way to resilience*.  
<https://www.credit-suisse.com/about-us-news/en/articles/news-and-expertise/does-size-matter-the-economy-of-small-countries-202305.html>

World Intellectual Property Organization. (n.d.). *Global Innovation Index*. WIPO.  
[www.wipo.int/global\\_innovation\\_index/en/](http://www.wipo.int/global_innovation_index/en/)

Yu, E. (2022, June 2). *Singapore officially launches digital platform to ease supply chain data flow*. ZDNET. [www.zdnet.com/article/singapore-officially-launches-digital-platform-to-ease-supply-chain-data-flow/](http://www.zdnet.com/article/singapore-officially-launches-digital-platform-to-ease-supply-chain-data-flow/)