Institutionalisation and destabilisation of the public research governance paradigm:

What can we learn about the next social contract for science from small industrialised democratic states?

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ABSTRACT

National Research, Science and Innovation (RSI) systems are marked by inherent tensions and competing expectations that drive their policy dynamics. Domestic governments expect to see impact from their investment, but the nature of that impact is often left implicit and open to contestation. At the same time, global actors are now calling for better coordination across national RSI systems and highlighting the centrality of RSI to enable large-scale socio-technical transformation. With this combination of pressures, RSI is a volatile area of policy-making where diverse actors, at multiple scales, struggle to define a shared sense of purpose and how to achieve it.

This context points to the need to better understand how national RSI systems change and adapt, especially as they are expected to be more societally purposeful at domestic and global scales. Yet, the scholarship and practice of RSI policy has tended to focus only on a narrow set of national academic and industrial outcomes, telling us nothing about multi-level governance and agenda-setting dynamics. To address this gap, this thesis applies a the lens of constructivist insitutionalism to analyse the rise and fall of national RSI governance paradigms over time. In doing so, it explores the potential for more purposeful and deliberate shift in the context of our current global crises.

Using New Zealand and Denmark as analytical models, the thesis demonstrates that national RSI systems have experienced little stability in recent years. Instead RSI has become a key site in which governments exercise their broader agendas, as the notion of investment in research has come to be interpreted politically. Thus, funding objectives and organisational arrangements experienced swings across the political spectrum, which often took for granted that what governments perceived to be in the national interest was also in the public interest. However, rapidly changing conditions are now throwing into question this implicit alignment of interests and drawing attention to where successive governments were (and were not) prioritising their RSI investment.

Case study observations challenge the traditional view of RSI as a generic system where simply getting the policy settings right will produce both fundamental and actionable knowledge as a global public good. Instead, national RSI systems are shown to reflect their multi-level institutional and material contexts, and the perspective of governments as they make sense of these contexts according to their own ideological commitments. These observations point to the challenges that lie ahead in prompting more purposeful and deliberate paradigm change if RSI is now to support socio-technical transformation at global scale. But this work also suggests points of intervention, each related to characteristics that distinguish governance paradigms: rationale, organisational arrangements, and key actors. Finally, this work contributes to constructivist and neo-institutional theory on governance dynamics, while adapting process-tracing methods to be more theoretically consistent. It also considers the utility of small country cases as analytical models more generally.

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DEDICATION

This thesis is dedicated to my late father who so wanted to attend “at least one of [my] graduations” and who encouraged me decades ago to “get things done before life gets busy.” I have failed on both counts, but at least now my teenagers know that I do finish what I start.

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PART 1 – ORIENTATION

Chapter 1 The *Newest* Social Contract for Science: A Governance Paradigm

> *In the face of increasing societal demands for scientific solutions, rapid technological developments, ever-growing concerns about persistent inequalities and related calls for openness, diversity and inclusivity, the practices of scientists and the policies of the institutions in which they work are under pressure to change. For the progress of science and its essential social utility, it is important that science systems throughout the world adjust to these developments in ways that safeguard scientific freedom and advance scientific responsibility, rigour and relevance.*
>
> International Science Council[1] (formerly ICSU) Action Plan 2019-2021, Challenge domain 4: Evolution of Science Systems (International Science Council, 2019)

1.1 Introduction

Of all public policy sectors, perhaps Research, Science and Innovation (RSI) may seem, at first glance, the least likely to be a battleground of policy ideas, political ideologies and societal values. Compared to more heated areas of public policy debate in environmental protection, energy, housing or healthcare, for instance, RSI is typically less visible to the general public. The sector is governed by its own epistemic community of elite researchers and innovation economists, and its policy debates tend to focus on strengthening the conditions for a knowledge-based economy and reasoned society. The public impact of policy decisions in RSI tends to be latent and its policy image has tended to be rationalist and uncontroversial.

[1] The ISC is the world's pre-eminent international organisation representing public researchers globally (www.council.science). Its membership comprises national academies and discipline-based scientific associations from across the natural and social sciences. Its mission is to be a "global voice for science" and the "advance science for the public good."

Accordingly, the policy literature on RSI policy and governance has conventionally emphasised material factors and structural path dependencies to account for the shape of the system. But this approach leaves the public interest and political nature of RSI largely unexplored. And yet, this is the very type of insight that is needed as the global community increasingly turns to public research systems to help deliver the largescale transformational knowledge and innovation that can end our reliance on fossil fuels and our devastating impact on natural ecosystems (Benner, 2018; Benner et al., 2022; International Science Council, 2021; United Nations, 2021, 2022; World Science Forum, 2015, 2022)

As this thesis demonstrates, RSI is a more heated and volatile area of policy-making than might be assumed. For one thing, its 'public investment' framing provides a ready license for governments to shape the sector in their own image and according to their own normative perceptions about the type of knowledge that society might want to invest in (or not). Yet, as the opening quote from the International Science Council (ISC) demonstrates, there is also an evolving set of multi-level actors and dynamics for national RSI systems to negotiate. Thus, calls for science to be protected from political interference, while at the same time providing solutions to society's urgent and shared problems, creates inherent tension because the definition and prioritisation of 'urgent problems' is a political exercise where national interests, public interests (national and global) and scientific interests may not always align (Wagner & Fukuyama, 2008)

The metaphor of an evolving 'social contract for science' has been used to describe the way in which these tensions must be balanced within public research governance. The metaphor conceptualises the evolving collective perception of the purpose of public research, which in turn influences how it is organised and governed. It is this ideational view of RSI

governance that is explored in this thesis, which asks: How do norms and ideas relate to structuring institutions and material conditions to produce new collective (or contested) interpretations (and therefore practice) of the social contract? First however, it is helpful to understand what is meant by the social contract, its evolution, and why it matters.

The changing social contract for science[2]

The original social contract metaphor was used to explain how the publicly funded research community justified its autonomy to self-govern and to choose its own research agenda in exchange for developing knowledge and expertise that would somehow eventually benefit the public (Guston, 1996; Lentsch & Weingart, 2011; S. Maasen & Weingart, 2008). This tacit governance paradigm was based on implicit public trust, rather than explicit oversight. It took as a given that institutionalised scientific norms[3] would underpin the legitimacy and integrity of scientific knowledge (Merton, 1942). Legitimacy and integrity, in turn, would underpin the social utility of the knowledge produced and thereby serve the public through new insights and technologies. Little thought was given as to *how* public benefits would come about or which ones might be needed. This method of science and

[2] Where it appears, the term 'science' is used broadly to mean the organised practice of publicly-funded research across the natural, physical and social sciences and humanities. The 'social contract for science' is used as a more common expression than 'the social contract for public research.'

[3] In 1942, sociologist of science Robert Merton codified the "four sets of institutional imperatives taken to comprise the ethos of modern science" and therefore underpin the legitimacy and credibility of scientific knowledge, unfettered by political or special interests. These 'Mertonian' norms are: Communalism (working as a community or practice to build a cumulative body of knowledge); universalism (the aim of generalisability); disinterestedness (the protection of the scientific practice from bias or interests); and organized scepticism (the communal aim of disproving a hypothesis so as to mitigate against confirmation bias).

research governance has been characterised by some scholars as the first-generation RSI governance paradigm (Arnold & Barker, 2022).

From the late 1990s, this notion of the social contract gave way to a second-generation approach to governance that shifted emphasis more explicitly toward ensuring (rather than assuming) the social utility of public research. In doing so, the concept of a '*new* social contract for science' began to emerge, privileging normative societal values, rather than traditional scientific values, as governance and policy drivers (Arnold & Barker, 2022; S. Maasen & Dickel, 2019). Specifically, the RSI policy discourse of industrialised democracies placed emphasis on the notion of impact of public research through its responsiveness and accountability to the public. In so doing, governments became increasingly directive about their expectations of the public RSI sector, including by prioritising specific thematic areas for research funding, and by supporting (largely unidirectional) attempts at technology transfer to industry, and knowledge transfer aimed at realising the public benefits of research.

Both the increased intentionality in RSI governance, and its presumed dual purposes were made evident, for instance, in the reporting exercises of member states to the multilateral Organisation for Economic Development and Cooperation (OECD). The OECD's biennial Science, Technology and Innovation (STI) review had long collected data on publications, patents, and firms supported by member states' national public research sectors. By 2017, however, indicators on how states also were supporting the social utility of research had been added to this data set (Borowiecki, 2018; OECD, 2020). The mere fact that the OECD was now collecting data on the framework conditions for societal impact revealed the significance of this new interpretation of the social contract for science, including how it

was broadening beyond an implied focus on innovation and economic competitiveness to also include societal challenges such as human and environmental well-being.

More recently, the *newes*t iteration of the social contract metaphor – a third-generation – has begun to emerge in the international arena. It explicitly addresses the collective *global* and *interconnected* nature of these societal challenges (Arnold & Barker, 2022; Diercks et al., 2019; Mattsson & Benner, 2022; OECD, 2023a). In this iteration, international science policy agenda setters are now calling on national governments to prioritise so-called 'transformative research and innovation' by aligning national RSI policy priorities (and thus funding) toward producing the kind of knowledge that is needed to act against widely recognised existential risks such as those encapsulated in the United Nations' Sustainable Development Goals (SDGs) (International Science Council, 2021; United Nations, 2019).

This call for global collective action in RSI policy-making and national system design is an important departure from the ways in which the first and second generations of the social contract for science paradigm were interpreted and applied to shape RSI governance regimes. Indeed some scholars argue that the latest generation is well and truly a new RSI paradigm-in-the making (Diercks et al., 2019; Schot & Steinmueller, 2018).

They suggest that this new "transformative paradigm" is distinguished from predecessors by: (1) its purposive and directional approach, not just to public research but extending to industrial policy and across all economic and public policy sectors; (2) its origins in climate action rather than coming from traditional academic and industrial RSI sector actors; and (3) its aspiration for a collective *global* RSI to support large scale socio-technical

transformations (Arnold & Barker, 2022; Benner et al., 2022; Borrás, 2020; Howoldt & Borrás, 2022; International Science Council, 2021).

If a new governance paradigm is indeed emerging, it is not yet stable. To the contrary, it has introduced a new dimension to the existing set of tensions in RSI policy dynamics. Already there had been the well-described tension between governments' expectation of nationally-relevant research while relying on assessment against internationally-held scientific interests and norms. Then there was the tension between industrial and social purposes of public research. Now there is the added expectation to align scientific, domestic *and* global interests, while also deliberately linking social and technological innovations. The International Science Council has characterised this tension inherent in the 'transformative research innovation' paradigm in the following way:

> In part, the insufficient research focus on the SDGs is the result of the constraints of available research funding […] Research funding prioritizes national scientific efforts that generate national benefits (particularly economic benefits) over international collaboration to achieve global societal and environmental benefits for the common good: about 80% of research projects involve only domestic collaboration, with the remaining involving bilateral (15%) and multilateral (5%) collaboration. (International Science Council, 2021)

To be sure, the ISC's observations came as the Covid-19 global pandemic had demonstrated that these multi-level tensions can be overcome when the purpose of public research is interpreted in the same way by actors at all levels. However, while the shock of pandemic may have fast-tracked that ability to reach a common vision, can such a shared interpretation of the social contract for science be sustained and applied to common threats that are more incremental, like climate change or biodiversity loss, overcoming national self-interest in how governments use their limited budgets?

It might seem self-evident to now harness the momentum of pandemic-era research governance to steer national RSI systems toward humanity's other major – if longer term – challenges in a coordinated way. However, as we emerge from the pandemic (at the time of writing), the opposite might also happen. That is, with national budgets feeling the effects of nearly two years of unexpected and unprecedented public expenditure, governments may be tempted to acutely refocus their RSI systems on commercialisable research and innovation directed at national economic competitiveness. If governments had trouble looking beyond their national border before the pandemic, will post-pandemic governance of RSI become even more nationalist than some had worried it already was already? Could we also see a "covidisation effect," in RSI systems, which would see funding channelled to gaps revealed by the pandemic, but to the detriment of other research priorities (Pai, 2020)?

Anticipating these concerns, the UN Deputy Secretary General launched the *UN Research Roadmap for Covid-19 Recovery* in late 2020. As an inspirational guidance document with no funding attached, the roadmap sought to align national public research systems around a shared concern that the SDGs should not lose the momentum of research investment in the post-Covid-19 recovery phase (United Nations, 2020; York University, 2020). But the Roadmap is also an indicator of the entanglement of interacting factors that shape policy perceptions and actions within a developing RSI governance paradigm. Encapsulated in this document is evidence of some of the multi-level institutional and material pressures that need to be made sense of and acted on by domestic RSI actors as they build a shared understanding of the purpose and governance of RSI in their countries. The roadmap is a deliberate and unprecedented attempt by a multi-lateral organisation to begin

building RSI governance consensus and alignment at the global level. In it, there is little mention of RSI for economic competitiveness – in fact, quite the opposite.

This introductory discussion of the metaphoric social contract, and its most recent iteration as an emerging third generation transformative RSI paradigm, serves to demonstrate that there is no easy stable consensus on the purpose of public research and what it means for it to be socially responsive. Instead, as will be elaborated in the case studies that follow, interpretations are socially constructed and reinforced within multi-level institutional and material contexts, where they are politically contested (Hay, 2008; Rein & Schön, 1996; Schmidt, 2008). Dominant interpretations are institutionalised in both implicit and explicit ways, and thus structure national RSI governance regimes in a self-reinforcing way.

This view is in contrast to the widely-held perception by RSI system actors (policy and scientific research communities) that theirs is a highly technical domain of policy-making for which the research community itself is assumed to be uniquely qualified to set priorities (Sarewitz, 2016), and in which policy-makers have long adopted a rationalist and incentives-driven calculous for decision making, aimed at maximising presumed national interests (Jaffe & Jones, 2015; Marburger, 2011; Stephan, 2012)

Instead, this thesis starts from the premise that the RSI sector should be thought of foremost as an area of *public* policy through which salient social values are expressed and their corresponding policy goals are enabled (Benner, 2018; Benner et al., 2022; Mazzucato, 2015; Sarewitz, 2011). Moreover, it is a policy sector that serves democracy itself, by seeking to ensure the supply of relevant knowledge and ideas to inform debates and decisions on issues of public relevance (Jasanoff, 2012; Lentsch & Weingart, 2011; Weinberg & Elliott,

2012). Therefore, the way in which governments' RSI systems are structured and the way they prioritise (or ignore) issues of public relevance through research governance can have profound public consequences. This is all the more so if the goal is now to align domestic systems toward globally shared challenges and transformation of entrenched societal systems (e.g., transport, food, finance, etc..). For these reasons, it seems the dynamics of RSI governance are ripe for an analysis that does not take for granted a commonly held sense of purpose but instead problematizes the perceived purpose as the very object of analysis (Arnold & Barker, 2022; Braun, 2006b; Flanagan & Uyarra, 2016; Martin, 2012, 2016).

1.2 Aims of the Study

This thesis takes the RSI systems of two small industrialised democratic states, New Zealand and Denmark, as analytical models to understand how norms and ideas relate to structuring institutional and material conditions in maintaining (or shifting) the prevailing approach to RSI governance. In so doing, it moves beyond strictly materialist and path dependent accounts of RSI governance. Instead, it traces the social construction and institutionalisation of the shared interpretation of purpose that underpin RSI governance regimes.

Specifically, through comparative case studies of the RSI systems in New Zealand and Denmark, this work seeks to disentangle the interplay of material, institutional and ideational factors that shape interpretations of the purpose of public research. It identifies key factors and how they configure into a framework of meaning – what some have called a self-reinforcing paradigm – through which this purpose is interpreted and operationalised (Daigneault, 2014; Flink & Kaldewey, 2018; Skogstad & Schmidt, 2011).

Thus, this thesis highlights how paradigm (or interpretive framework) construction and institutionalisation are political and contested processes in which actors make sense of multi-dimensional factors that are both endogenous and exogenous to the RSI sector and to the states themselves (Hay, 2017; Musselin, 2011). Understanding the evolution of RSI governance in this way offers new conceptual tools and insights for policy practitioners that could help raise the sector's self-awareness as well as its external profile as both an expression of public values, and an instrument of societal transformation.

1.3 Positionality Statement

My interest in the evolving perceptions of purpose in public RSI systems, and how these play out in governance regimes, stems from nearly two decades as a science and research policy practitioner. I have experience in a variety of RSI contexts including in medium and small systems, federal and unitary countries, and at the multi-lateral level. I have served in ministries of industry, national funding agencies and offices of Chief Science Advisors across the political spectrum. I have engaged in the development of national strategic plans and policy statements for RSI systems, as well as national system assessments using internationally recognised RSI indicators. I have also served in the administrations of universities and university-based research centres where the impact of changing government strategies and priorities was acutely felt.

This thesis is therefore practice-inspired and practice-oriented research (Cairney, 2015; Cameron, 2023; Carboni et al., 2019; M. Evans, 2007). The experience of shifting perceptions of RSI sector priorities and approaches with each change in government was formative. So too was the aftermath of the Global Financial Crisis, and later the advent of the global Sustainability Agenda, when governments and the research community increasingly

seemed to be reframing RSI instrumentally, each according to their own perceptions of purpose.

Thus, in seeking to connect theory with practice, I began this work with a practical lens in the first instance. This approach invited a broad reading of diverse literatures from multiple theoretical traditions and reconciling academic, practical and colloquial languages and perspectives. Ultimately, my choice to focus on how ideas and perceptions come to be shared and then institutionalised, which typifies constructivist approaches, resonated best with both my RSI policy experience and empirical case study data. At the same time, the work's origins in practice, rather than an academic puzzle, compelled me to challenge theory against experience. In this way, I do not automatically reject the potential influences of material interests or path dependencies, but nor do I take up the purely critical project of constructivism. Instead, I am interested in the exploratory flexibility of constructivism and in leveraging the tools it offers to reveal assumptions, challenge policy logics, and demonstrate how things come to be as they are, and thereby how that they could be different in a sector that trades on its societal relevance. My hope is for a practice-oriented, theoretically-informed contribution, which starts by recognising the politically constructed nature of the RSI sector.

1.4 Clarifying Concepts

Before going further, some conceptual clarity is necessary because it justifies both the theoretical and methodological choices made in this thesis. First, it is important to be clear about the level and object of analysis.

The public research system as the level of analysis

The case studies of New Zealand and Denmark are centred on their public research systems, defined by Thorsteinsdóttir (2000) as:

> […] a network of research institutions that are publicly owned or controlled and operate mostly on public funding with the goal of promoting both 'investigator-led' and 'mission-oriented' research that is aimed at advancing societal or economic interests as determined by government. (Thorsteinsdóttir, 2000)

This definition includes tertiary education institutions, for which there is the additional mandate of protectors of intellectual freedom. More recently, an encompassing model that links the Public Research System and the industrially-focused 'National Innovation System' (B. Lundvall, 2007) has become commonplace. However, the extent to which these are viewed as an integrated whole can vary between actors, countries and paradigmatic periods, as will be seen.

For instance, the sector's epistemic community of scholars and practitioners has tended to self-describe using the common catch-all term 'science system' (European Commission, n.d.-b). This label is sometimes used interchangeably with the narrower 'public research system' or the broader yet distinct 'innovation system.'[4] These instances of conceptual slippage may signal unexamined assumptions or deliberate discursive choices

[4] Depending on the government of the day, the notion of a 'public research system' may be bundled with 'innovation system' in the minds and discourse of political decision makers, particularly if their main focus is on the economic return on investment of the public research system. For instance sector observers in Canada witnessed the discursive shift toward greater use of the word 'innovation' during the Conservative government of Stephen Harper (Kinder & Dufour, 2018). Similarly, in NZ the rise of innovation discourse became pervasive during the years of centre-right government (Leitch et al., 2014). But ideology is not the only contributor. The research community itself also has been known to justify public expenditure by emphasising its contribution to economic growth and global competitiveness through innovation, to secure government support for their work by "framing it in terms governments would understand" (Dufour, P. Pers. Comm. 2019).

made by actors. In either case, they should not go unnoticed because of the material impact they can have when they are operationalised through government research priorities and funding mechanisms.

Thus one empirical task in the case studies is to take notice of when, by *whom*, and under what conditions the labels 'research', 'science', 'innovation' and even 'higher education' labels are deployed in policy discourse, and to what effect (Leitch et al., 2014; Whitley, 2011a; Woelert, 2015). Table 1 suggests textbook definitions of terms, which provide a general template against which to compare how they are used by actors. Instances of changing usage are noted in the case studies in Part 2.

Table 1: Definitions and relationships between science system, research system, innovation system and RSI

Research, Science and Innovation (RSI) system	**Science system**	**Research system**	Aims to develop research 'talent,' or the 'pool of expertise', including attracting international and increasingly diverse and early career research professionals
			Aims to build and maintain research infrastructure, such as university and government labs, libraries, databases, specialised equipment, etc.
			Aims to allocated resources, which are often in the form of competitive and non-competitive grants in a variety of formats and sizes, to individuals and organisations
			Aims to create opportunities for public engagement and for fostering a culture of evidence use
		Aims to create knowledge mobilisation mechanisms to help inform public policy	
		Aims to set frameworks, tools, mechanisms and procedures for government to fulfil its regulatory responsibilities through scientific monitoring and evaluation activities	
	Innovation system	Aims to support through a variety of personnel and fiscal measures (directly or by incentive) industrial firms to become more knowledge-driven by undertaking or commissioning research to improve their products and/or practices. Innovation policy is distinct from, but intersects with science policy, particularly where policymakers perceive 'societal responsiveness' in a mostly economic framing. In such systems universities and other public researchers are encouraged and enabled to work closely with industry	

Source: Based on (Council of Canadian Academies, 2017) and J. Kinder, Institute on Governance 2018 pers. comm.

In this thesis, the analytical unit of interest, is mainly the national public research system (greyed box above) as it is nested within the broader science system. Comprehensive analysis of the industrial context necessary to analyse the full RSI system is beyond the scope

of this work. However, the thesis does observe the ways in which the science system is viewed as distinct from, but conceptually linked to, the innovation system. It notes that this conceptual link is expressed to greater or lesser degrees in different countries and at different points in history, for instance by coupling or decoupling industry and higher education ministerial mandates.

Thorsteinsdóttir's definition also parsed public research systems by function. Investigator-led research is most often (but not exclusively) associated with universities. Mission-oriented research is most often (but not exclusively) associated with government labs or other public research organisations (PROs). In the two decades since Thorsteinsdóttir's definition, however, the functions and structures of public research systems have diversified. A new class of structure has emerged in the form of multi-organisation and multi-disciplinary research platforms, which are aimed at promoting greater researcher collaboration around identified societal and environmental 'missions' (Borowiecki, 2018). Such platforms often take the form of multi-disciplinary Centres of Excellence, Grand Challenges or problem-oriented Research Networks. They are emblematic of the second-generation new social contract paradigm by giving effect to the policy imperatives of responsiveness and accountability in public research priorities and practices.

Governance regime dynamics and what is meant by 'paradigm'

The next concepts to clarify are the notions of governance regime dynamics and the understanding of policy paradigms. Dynamics include how the public research sector is organised and structured through institutions (rules), organisations and actors. But they also include the non-structural (ideational) aspects of the sector's governance regime, the governance paradigm for RSI. Here, paradigm is taken to mean the shared tacit understanding

of the purpose or public research and therefore how it should be organised and governed. It is the dynamic processes of constructing, institutionalising (or destabilising and replacing) this paradigm that are explored in this thesis.

Taking a sector-wide perspective on dynamics of governance regimes contrasts with the more typical approach in policy-change literature, which tends to consider changes to specific policy decisions or instruments only. However, for this thesis a much broader scope is necessary because, in the words of science policy scholar Kari Aagaard:

> …the funding system as a whole has come to be seen as the main tool for the implementation of research policy. The level of funds available and the criteria adopted for their allocation are accordingly viewed as being closely linked to policy objectives. (Aagaard, 2017 p.283)

To be sure, governance regimes are dynamic and evolving across policy sectors generally, both in their institutional settings and corresponding operational arrangements. For instance, sectoral regimes are becoming less hierarchical, more open, networked and consultative with non-state actors (Capano et al., 2015; Te Kawa, 2023).

Interestingly however, for the public research sector, the evolution of governance has a uniquely reversed trajectory. As explained in the introduction to this thesis, historically public research has been governed nearly autonomously by its own community of non-state actors, under the social contract model. The conventional autonomy to self-govern afforded to the research community kept the system largely stable for decades, relying on the tacit social contract.

Now however, the sector is experiencing more centralised monitoring and steering by the state in a bid for better alignment of public knowledge production with public policy goals (as defined by the state). As will be seen in the case studies that follow, it is the growth in

government intervention that has created tension and instability in the system rather than playing a stabilising role.

As one senior research policy practitioner observed, it is an increasingly complex system, which has gone from “fund and forget” to “fund and follow” (A. Mota, personal communication, 2018). More recently, one could argue that this model has evolved a step further to become ’frame, fund, and follow’ (including from a broader range of perspectives). Finally, it is tempting to extend the alliteration given the calls of multilateral agencies for globally aligned national RSI systems to address the SDGs. Will the newest governance paradigm now be seen as ‘(foreign)framing, fund and follow’?

Alliteration aside, research governance is understood here not as a linear and inevitable evolution, nor as a rational and objective exercise in steering for utility maximisation. Rather it is a dynamic and multi-scale process of sense-making and the institutionalisation of certain interpretations of the purpose of public research. Consequently, the research system itself is viewed as a complex and dynamic ecosystem.

As indicated in the positionality statement, and further discussed in chapter 3, this view of public research governance dynamics influences my choice of theory and methods that guide this thesis. First, because it is fundamentally a study of changing governance, the ‘policy change’ literature would appear to offer some promise. However, the public research sector is not driven by the intervention logic of a policy problem to solve but rather a value proposition to optimise. Nonetheless, elements of the policy change approach are instructive.

Thus, both bodies of literature relating to governance and to policy change guide this work theoretically. However, in doing so, the work avoids both the static view that categorises

governance regime types, which is characteristic of the former, and the detailed approach to micro level mechanics of change processes, which is most often seen in the latter (Capano et al., 2015). Although these approaches have their advantages in offering the ability to test hypotheses and provide apparently causal explanations of change, this thesis is interested instead in the interplay of factors involved in the dynamics of construction, institutionalisation, and eventually, the destabilisation of a shared perception of purpose within the public research governance regime, and the governing approach to achieving it.

Why analyse small countries' public research systems?

Two detailed historical case studies are used to examine RSI governance dynamics. For reasons detailed in section 4.3 (Case Selection), New Zealand and Denmark were chosen as the study countries. Examining small states facilitates a view of governance dynamics that is multi-factor, multi-level and system-wide. At the same time, case comparison helps to render visible by contrast the key constraints, junctures, interpretations and actions in paradigm and regime construction. In other words, small state public research systems are used here as a model to more easily identify and examine key factors (Brady & Thorhallsson, 2021; Thorhallsson, 2018; Veenendaal & Corbett, 2015). In doing so, the thesis also aims to test the rigour of using small countries as illustrative models. Lessons from this approach are discussed in section 10.2.

Briefly, it is assumed that tensions and debates are naturally amplified in small state settings. Material constraints and vulnerabilities are associated with small size, including exposure to the variability in the global economy (Skilling, 2020). To be sure, the Covid-19 pandemic has already become an acute inflection point that has shaped the paradigmatic lens through which nearly all public policy questions are interpreted and addressed, and the

governance of the RSI system is no exception. Yet the pandemic, like the Global Financial Crisis (GFC) or the Cold War for that matter, is but the latest contextual feature to present material constraints that must be made sense of by policy actors. Thus, tracing the processes and influences on the construction of a shared interpretation of public research in small and easily observable RSI systems of industrialised democracies over a significant period of time may help to develop a generalised understanding of public research system dynamics. Moreover, the small size of countries may offer a way to test the strength (and thus potential generalisability) of findings. That is because small countries have been shown to engage in 'shelter seeking' and 'status seeking' as mechanisms of geo-political self-protection (Thorhallsson et al., 2018). Thus, in instances where such behaviour would be expected but is not observed, countervailing factors must be especially compelling. The methodological merits of small countries as study models is further discussed following the exposition of case studies, in Chapter 10. If small countries can be shown to be reliable RSI system models, they could offer some insight into the future prospects for the kind of alignment and collaboration that would be necessary to help embed the third-generation Social Contract for Science.

Though some suggest that size is a relative concept (Baldacchino & Wivel, 2020; Mouritzen & Wivel, 2005) and apply distinct lenses including political size and perceptual size (Thorhallsson et al., 2018), more conventional definitions of a small state point to its population size and gross domestic product as indicators of 'small' (Campbell & Hall, 2015; Katzenstein, 1985, 2003). Various definitions invoke population thresholds as low as 1.5 million (Commonwealth Secretariat, 2022) and as high as 10 million people . For the purposes of examining RSI systems, however, there is a general consensus among international organisations, economists and policy makers that a national population of 5 million is a

standard below which some national institutions and infrastructure may be seen to be uneconomic investments (Forsyth, 1990). Thus 5 million people is a rough threshold which can be expected to force choices about prioritising public investments such as research and innovation (Lederman & Lesniak, 2017).

Indeed, because the social value of research is not intrinsic but politically constructed, the case for investment is not a given. It rests instead on how the sector's responsiveness and accountability to the national context is interpreted. In small countries this naturally puts a spotlight on the dynamics of the governance regime and how its underlying paradigm is maintained or destabilised. For instance, small research systems may feel more acutely the tension between funding priorities that are set nationally, and standards of research quality, which rely on attracting the interest and endorsement of international scientific peers (Carayannis et al., 2016; Edquist & Hommen, 2009; Wagner et al., 2015). Similarly, small size may render more visible national susceptibility to transnational or supranational policy pressure, whether material or ideational. Yet despite offering such a unique window onto research governance dynamics, policy-*making* for RSI systems in small states is surprisingly understudied compared to larger trend-setting counterparts like the US, UK or The European Union.

Instead, where size has been considered in the literature, it has been almost exclusively through the lens of material constraints on system performance (Edquist & Hommen, 2009; Thorsteinsdóttir, 2000). For instance, the literature indicates the challenges of small size on: research system efficiencies (Carayannis et al., 2016; Edquist & Hommen, 2009); shallowness of expertise (Davenport & Bibby, 1999); lack of intellectual diversity beyond limited 'elite' researchers (Bruyninckx, 2005) due to risk-aversion of peer review in

resource-constrained settings (Luukkonen, 2012); and often a reliance on external research investment, with the associated vulnerability to its potential influences on the research or research agenda (Karo & Lember, 2016).

In the few cases where policy-making dynamics of small RSI systems have been considered, a key observation has been small states' tendencies to conflate technology and innovation policy with research policy (Glod et al., 2009). Moreover, this view is often maintained through policy monopolies, which can be common in small systems (Masso & Ukrainski, 2009; Ukrainski et al., 2014). Case studies have shown that small states experience challenges in diversifying the policy rationale for public research beyond the innovation and economic competitiveness narrative (Borlaug, 2015; Karo & Lember, 2016). Thus, when the rationale does change, understanding the dynamics of how and why this happens can be all the more enlightening.

For such an analysis, a conceptual appreciation of size, beyond the lens of material constraints, can add depth. Not only does small size amplify the material constraints which shine a light on the implicit politics of paradigm institutionalisation/destabilisation processes, but as a self-perception, the notion of 'small' can also be an interpretive filter or a discursive tool in its own right (Porter, 2011; Thorhallsson, 2018). Understanding this can help reveal the role of national self-perceptions in sense-making and paradigm construction. Yet, the ideational power of self-perception and labelling is largely ignored in the RSI policy and governance literature, which focuses most on material incentives and path dependencies as driving factors, rather than the interplay of material and ideational factors (Hay, 2008, 2017; Schmidt, 2017).

By contrast, using the lens of size, this thesis contributes to recent debates in the neo-institutionalist policy literature that have taken the 'constructivist turn' in recent years. It rejects the reductionism of strictly linear causal claims to explain governance regimes. Instead, it identifies and analyses the set of complex, contextualised processes in constructing, institutionalising and destabilising governance paradigms that shape public research governance regimes (Hay, 2016b, 2017; Zittoun, 2009). In doing so, it does not discount other neo-institutionalist perspectives, but accepts that paradigms are shaped by interpretations of material conditions and institutional legacies of national context as actors make sense of their context (Musselin, 2011; Porter, 2011; Skogstad & Schmidt, 2011).

Thus, the work takes up the scholarly debates about the interplay of institutions and ideas (Beland & Cox, 2010; Béland & Waddan, 2015) including transnationally (Skogstad & Schmidt, 2011). More specifically, it posits that the *nature* of this interplay is a deep interdependence and mutual reinforcement which is historically and materially conditioned. It is this appreciation of the interdependent ideational, material and institutional factors that not only helps advance the understanding of national differences and similarities in public research governance regimes (Campbell & Pedersen, 2015; Schrad, 2010), but also the understanding of the political nature of these regimes. In an era of climate crisis and pandemic recovery, not to mention post-truth politics that has seen both government support for research - or its absence - leveraged for political gain, it is more important than ever to understand the dynamics and politics of research governance paradigm construction, and the regimes they shape.

1.5 Overview of the Thesis

The thesis is divided into three parts: an orientation, case studies, and observations with discussion. The remainder of PART 1 comprises three chapters to complete the orientation component. Chapter 2 lays out the generalised historical context of evolving public research governance regimes globally. It examines the paradigmatic shifts in policies and practices and the material conditions, institutional legacies, and their evolving interpretations, which together have triggered governance regime changes over time.

Chapter 3 introduces the constructivist conceptual framework, which has been hinted at already. It first surveys the strengths and weaknesses of various neo-institutionalist approaches to RSI governance scholarship. It then suggests a hybrid model that considers the material conditions and path dependencies championed by Historical Institutionalists, with discursive and ideational (constructivist) scholars' interest in sense-making and the influence of governance paradigms (Blyth, 2016; Blyth et al., 2016). Ontologically, the study considers both institutions and paradigms as mutually-constituted rather than material 'givens' (Schmidt, 2017; Zittoun, 2015). It does not ignore the structuring role of material conditions and the path-dependency of institutional contexts, but sees their influence as the product of sense-making by regime actors actively constructing a shared understanding, rather than being intrinsic (Hay, 2016b, 2017).

The theoretical framework thus encourages a deep historical understanding of the interdependence of multi-level institutions, material conditions and shared interpretations held by regime actors (Campbell & Pedersen, 2015). In turn, it considers how these factors configure to create the conditions for a regime's governance paradigm to become destabilised and replaced over time.

Chapter 4 lays out the data collection and analysis methodology. To begin, secondary research, together with national level policy documents and supplementary key informant interviews were used to develop historical timelines of governance regimes in New Zealand and Denmark. Next, distinctive periods within each country's timeline were identified. Identification of each period was done by detecting coherence across four characteristic features of a governance paradigm, to assess whether these periods might constitute paradigm change. The features, derived from the relevant policy paradigms literature (Daigneault, 2015; Hogan & Howlett, 2015; Kern et al., 2015; Skogstad & Schmidt, 2011), are:

1) Statements of rationale (the 'why?')
2) Policy objectives and thematic priorities (the 'what?')
3) Operational arrangements (the 'how?')
4) Roles and mandates of actors, especially the role of the state (the 'who?')

Any loss of coherence across these defining features, or apparent loss of resonance with material or institutional context was then noted in the case studies because it suggested paradigm destabilisation and the potential for replacement. But whereas instability and change was noted between distinctive periods, full paradigm replacement appeared to be largely limited to the first and second generations of RSI governance (Arnold & Barker, 2022). A third paradigm seems only just to be coming into view, with the increasing instability and frequency of distinctive periods in each case chronology. The empirical case studies are presented in PART 2 and summarised in tabular form in Appendix 3.

PART 3 returns to central questions of this thesis on the institutionalisation of research shared perceptions about the purpose of public research and how they shape governance regimes. By comparing the distinctive periods within and across cases to detect paradigm instability, five key observations are made. The last chapter suggests three practical

implications of this work for potential third-generation public research systems. The chapter ends with some thoughts on a research agenda that builds on the empirical and theoretical insights of this thesis.

Chapter 2 Overview of Trends in Public Research Governance

> *"Science policy differs significantly from other policy areas: the knowledge producers in the form of scientific communities require far-reaching autonomy in the steering and coordination of science as an essential precondition for creative scientific action. Due to this, classical science policy is caught in the dilemma of defending scholarly autonomy while making sure that societal needs and demands are adequately taken into account during the knowledge production process. The competing paradigms are reflected in the science policy discourses on 'excellence and 'relevance' or impact."* (Simon et al., 2019)

This chapter surveys the literature on the evolution of RSI governance regimes through their distinctive governance periods. The chapter concludes by adding to and updating previous periodisation work undertaken by science policy scholars (Braun, 2006b) and by adding necessary detail to the three paradigmatic governance 'generations' posited in the literature (Arnold & Barker, 2022). It identifies six distinct global periods by their characteristic features: policy rationale; policy priorities; operational mode; key actors and their roles. This generalised timeline provides a global backdrop against which to view the evolution of public research systems in New Zealand and Denmark and, in particular, their potential for the next paradigm change.

To begin, the current governance and organisational arrangements of national research systems in most democratic western states is best understood in historical context. Transnational institutions – from colonialism to economic globalisation – and the material and ideological impacts of world wars created the institutional template for public research systems. National variations of this template depended on material and institutional contexts, mediated by local interpretations. This chapter provides an overview that sets the stage for case studies of New Zealand and Denmark in Part 2.

2.1 Origin Stories: Research Systems in Western Democracies

In the case of settler states, early national public research systems largely grew out of nation-building efforts of colonial institutions and the material exploitation of resources. In Anglophone settler states like Canada, the United States, New Zealand and Australia, national institutes of agricultural and of geological sciences are the recognised pioneers of public research systems (Doern & Kinder, 2007).

Western European research systems have different origin stories, however. That is because higher education on one hand, and agricultural and resource practices on the other, were well-established in Europe compared to 19th and early 20th century America or Oceania. However, European universities were largely aimed at humanities, theology, and the reproduction of the elite ruling class, while the Humboltian tradition, research and experimentation came much later. Its financing by governments, rather than by the church or private patrons, came later still.

Meeting perceived material needs

In early 20th century Europe, it was the fulfilment of material needs for energy (for manufacturing processes) and in some countries, the perceived need for defence science, which promoted and structured early public investment. The structure of these systems responded to pre- and post-war historical influences, the legacies of which are still seen in the shape of research systems today (Campbell & Pedersen, 2007, 2015).

In settler states – setting aside specifically funded defence science within universities and industry – support for war efforts would also lead to diversification of initial research and development activities. It would add medical, social and nutritional research alongside

existing expertise in agricultural and natural resource sciences (Bush, 2020). In the US, the war effort left a legacy of energy and defence research by virtue of the material resources in these sectors to invest in major scientific instrumentation. By the end of the war, public and private investment in research had increased, and the system of labs and links to industry and universities had grown. This growth necessitated more formalised research governance practices (Marburger, 2011).

2.2 Institutionalising the 'Scientific Freedom' Governance Paradigm

Following government war-time investment in research and development, the US and the UK emerged as the world's influential research powerhouses among Western industrialised countries. As such, the formalisation of research governance in the Anglophone West, and the institutionalisation of the particular governance paradigm of the modern period, can be traced to the global influence of the writings of Robert Haldane in the UK (1918) and Vannevar Bush in the USA (1945). Each served his respective government with policy advice during or after wars, when science and technology arguably enjoyed a privileged place on the public policy agenda. Their works are considered the normative blueprints of the governance paradigm for Western public research systems (Kinder & Dufour, 2018; Vinck, 2010). Certainly, this was the case for much of the industrialised Anglophone world; European RSI systems had a different evolution, partly prompted by fear of a post-war brain-drain of physical scientists to the US, but also as part of a larger European integration project, as will be explored in the Danish case study in Part 2 of this thesis.

Though separated by time and place, both Haldane (UK) and Bush (US) called for scientists to be encouraged and enabled to fill nationally identified knowledge needs, while also remaining autonomous and able to work without government interference. So significant

was this concept of scientific freedom in establishing and justifying the self-governance of the public research community, that it was expressly labelled and adopted by the British Academy as "the Haldane Principle" based on the separation of policy-focused research which government departments could oversee and more general research, for which funding decisions should be left to autonomous research councils (Willetts, 2010). For decades the Haldane Principle remained an informal institution under which public researchers could claim freedom of thought and practice. In later years, public concern about the state of funding for environmental and other public interest research, saw the principle institutionalised and enshrined into law (Ghosh, 2017).

Marshalling Scientific Freedom to institutionalise self-governance of the research community

The Haldane principle in the UK and similar positions on research community self-governance in the US were legitimised by a generally shared understanding (though somewhat reluctant acceptance by governments at the time) that the credibility of scientific knowledge is ensured by the integrity of research practice (The British Academy, 2019). Moreover, this practice had to be unfettered by external influences. Such integrity of practice is founded on the commitment of researchers to self-question, to publish their work and thereby to subject it to peer scrutiny within a community of practice. These scientific norms, which were codified in 1942 by Robert Merton (see footnote 4, Chapter 1), underpinned the process by which the research community validated and endorsed new knowledge to a 'scientific' standard. Implicit in these norms was the assumption that none other than the professional research community has the expertise to assess not just scientific knowledge, but also the direction of research, its progress and its potential application. Any broader social

value was simply assumed. At the same time, any perceived social interference was explicitly challenged.

Thus, from these foundations in the writings of Haldane, Bush and Merton, the institution of scientific autonomy extended to the broader organisation and governance of public research. Therefore, the acceptance of researchers (especially elite researchers) as policy actors in their own right went unquestioned by state actors and the public. Indeed, the research community enjoyed majority influence in steering its own resources, which were largely forthcoming from governments eager to grow economies and establish knowledge sovereignty. Factors that enabled such influence included: the relative lack of public controversy around scientific and technology issues; the relatively low public salience of the research sector; and the apparent technical knowledge required to suggest the types of investment needed (Sarewitz, 2016). From these conditions, the tacit social contract for science emerged.

Institutional stability: A self-reinforcing governance paradigm, and the influence of supra-national actors

It was this social contract that kept the research policy regimes in most western industrialised democracies relatively stable and largely uniform throughout much of the early 20th century. The appointment of elite researchers to high-level administrative roles within universities, research institutes and funding councils ensured a closed and self-reinforcing governance paradigm and regime. The state's leverage was largely limited to annual budget allocations to scientist-run funding agencies under a 'principal-agent' relationship (Guston, 1996). Bulk funding for universities to employ teaching and research staff was a common

arrangement in many early governance systems, sometimes through a combination of public money and industrial philanthropy (Whitley, 2011b; Whitley & Gläser, 2007).

The stability of this self-reinforcing governance model was further bolstered by the influence of the OECD in diffusing a template for research governance through its monitoring and advice services to member states. The OECD was (and is) the pre-eminent multi-lateral policy agenda-setter in science and research policy for advanced industrialised economies. In the early 1960s, it undertook systematic policy diffusion to address the lack of any other point of reference for research policy making and governance (Henriques & Larédo, 2013a).

At the first OECD ministerial conference on science policy in 1963, only five countries had even the seeds of national science policy or organised governance practices, and "the OECD therefore set about constructing a policy model to promulgate through its service of national policy reviews" (Henriques & Larédo, 2013a). [5] The early model was based largely on the adaptation of prevailing budget allocation and 'expert' science advice mechanisms already used in dominant member states. These mechanisms were later codified – and therefore legitimised – within the OECD's *Frascati Manual*.[6] Frascati served as an important

[5] Of relevance to this thesis, it is noted that Denmark ratified the Convention of the OECD (i.e., became member) in 1961, while New Zealand did so in 1973.

[6] An excerpt from the 2015 edition of the Frascati Manual explains its policy influence and in particular, its role in bolstering an 'economic impact of research' paradigm for member states since 2008: "The Frascati Manual is not only a standard for R&D data collection in OECD member countries. As a result of initiatives by the OECD, UNESCO, the European Union and various regional organisations, it has become a standard for R&D measurement worldwide. It is also a recognised standard in other statistical domains, such as in education and trade statistics. And in the 2008 revision of the System of National Accounts, it was the Frascati Manual's definitions of research and innovation that were used as "the basis upon which to treat, for the first time, expenditures on R&D as a capital formation activity, i.e., investment."

tool to externally validate, reinforce and help institutionalise the research community's role in governance and policy-making.

It has been suggested that the processes of diffusion and national institutionalisation of the dominant OECD model from the mid-1960s hinged on the national review and advice exercises that the OECD conducted in member states (Henriques & Larédo, 2013a). A major factor that promoted the model's uptake was that national reviews were done at the request of the state. This meant that only those countries which were already convinced of the need for coherent research governance requested a review and were more likely to heed OECD advice. Soon, competition among member states would lead to an increase in review requests. The various national governance models therefore converged and stabilised around paradigmatic assumptions about the autonomy of the research community. The demand for external national reviews diminished as the national mechanisms of expert advice became embedded.

Institutional reinforcement through Cold War ideology

From mid-century through to the late-1970s, researchers in most Western industrialised states continued to enjoy the odd combination of Keynesian-type state engagement through expenditure, and a continued laissez-faire governance attitude that allowed for intellectual freedom and curiosity within defined sectors of national interest. The changing geopolitics of the Cold War period sparked renewed government interest in the instrumentality of public research to meet government objectives. But leading research-intensive states maintained a measured approach. Indeed, the paradigm of a self-governed public research system was given institutional prominence during the Cold War in the trend-

setting United States through the influential writings of Michael Polanyi in his 1962 classic *Republic of Science* (Polanyi, 2000).

As research governance mantra, Polanyi's self-organising *Republic of Science* approach to governing the sector carried a political message. It emphasised the notions of 'purity' and 'freedom' of western science. This was a deliberate and useful counterpoint to the Soviet research governance paradigm of highly-centralised and government-directed activity (Vinck, 2010). To support an autonomous public research system in the West, therefore, was seen as an exercise in Cold War assertion of freedom as a political ideology and of nation (re)-building.

In Western countries unaffected by war at their doorstep, much post-war science funding thus went to technological and manufacturing research to help improve national capacity in industrial development. In the US especially, funding also went to Cold-War defence and the Space Race[7]. At the same time, war-affected states in Western Europe focused on rebuilding infrastructure and strengthening core industries and communities, but also on Cold-War-driven technology development and social research (Rip, 2007; Rip & Van der Meulen, 1996).

[7] For instance, in the neighbouring Canadian public research system grew up around natural resource and agricultural foundations that were similar to the US, however it was less well connected to private philanthropy and industry. Canadian aerospace research nonetheless was boosted by the structuring material reality of geography. The availability of rural land in a (then) Dominion of the Crown meant that Canada became a key training and engineering centre for the Royal Air Force during in WW2. The legacy of this capacity continued after the war and many Canadian engineers and designers would find employment with the National Research Council, Boeing, and Avro Corporations. Cold War investment by the Canadian government and military was evident in the Distant Early Warning capabilities established across northern communities and hinterlands and an aerospace research program to build a supersonic defence jet. When then Canadian Prime Minister Diefenbaker abruptly called off the supersonic program in early 1959, many of its highly skilled personnel migrated to the US's growing NASA lunar mission as the Space Race captivated the public and science policy discourse.

From overt ideology to appeals to economic competitiveness

As the Cold War waned through the late 1980s, it ushered in an era of economic globalisation in the 1990s. A new interpretation of the social value of research, and new material and institutional conditions ushered in a new paradigm. This time it was characterised by governments and publics increasingly looking to the research community to drive 'national competitiveness' in the transition toward a more knowledge-based economy (Etzkowitz, 2011). By now, the traditional split between industrial, government and academic research was shifting in a more obvious way in the industrialised West. University-based researchers, working in the Humboltian tradition and under protective higher education legislation, would continue largely to enjoy intellectual freedom. However, changing institutional conditions in both in the US and in Europe would precipitate, universities' interest in commercially appropriable research and industry partnerships. Governments both encouraged and engineered this phenomenon through the design of funding opportunities and institutional change.

For instance, one of the most influential institutional changes of the period came in the US when the 1970s recession prompted government to want to maximise its 'return on investment' in research done by universities. However, at the time intellectual property developed with public funds was considered to belong to the state. Yet the state had little capacity to exploit patents, leaving them to languish (Marburger, 2011). Thus, the passing of the Bayh-Dole statute in late 1980 was an institutional game-changer (Patent Rights in Inventions Made with Federal Assistance, 1980). It enabled universities themselves to hold patents on inventions produced in their labs with government money.

With Bayh-Dole, US universities had the incentive to develop the work their researchers produced. This institutional incentive enabled and encouraged greater prioritisation of market-oriented research by universities, just as the new field of biotechnology was showing commercial promise. Bayh-Dole helped to give rise to the concept of the notion of the entrepreneurial university and to the broader understanding of the economic instrumentalism of public research activity in a diversifying a so-called knowledge-based economy. The global influence of this new perspective would take time to become established as a new paradigm. In steering the perceived social purpose and value of universities closer to the innovation (i.e., private industry) sector, however, this paradigm remains a highly contested within RSI systems today.

Science studies scholar Arie Rip has suggested that the role of public research as innovation engine really began to take shape with the establishment of specialised academic research institutes sitting outside of the classical disciplinary structures in the mid-1980s. By the early 1990s, many research-intensive Anglophone universities also had established Technology Transfer Offices (TTOs) to handle industrial relations and the management and exploitation of universities' intellectual property (Rip, 2007). This suggests that ideas about public-private collaboration co-evolved with the institutional design that enabled them to become entrenched. That is, putting ideas into practice outside of conventional structures opened up the possibility that industrial research could be done within the academy, and the establishment of TTOs then normalised and entrenched the idea further towards a new governance paradigm.

2.3 Destabilising the Dominant Governance Paradigm

The potential for commercial gain from public universities was an institutional disruption that changed the conditions of legitimacy for public research. Consequently, the dominant scientific freedom paradigm was destabilised, allowing new ideas about the purpose of public universities and related Public Research Organisations (PRO) to take hold. Moreover, the new notion of an 'entrepreneurial university' required new governance mechanisms and expertise. This brought business leaders, alongside elite scientists onto university governance and advisory boards (Barringer et al., 2022; Slaughter & Leslie, 1999). Once in place, these new actors would further reinforce a new governance paradigm which refocused attention on entrepreneurialism and innovation. This change was becoming increasingly evident in the sector's growing emphasis on technology development and business-facing programmes throughout the 1990s and early 2000s. The influence of this paradigm continues to be contested within the higher education sector globally, especially as investment in Liberal Arts and Humanities programmes has diminished (Barstow et al., 2021).

Transnational ideas confront the distinct institutional context of Europe

In Europe, commensurate governance change would take longer to become established in a more complex institutional and cultural environment. The many diverse and entrenched public university traditions across Europe were otherwise entangled in the dual aim of advancing economic competitiveness and the larger project of European integration through national institutional reforms. At the turn of the new millennium, the European Council released its Lisbon Strategy with the aim of making the EU "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" by 2010 (European Council, 2000). To

achieve this aim, the strategy's architects looked to the now-established twin concepts of 'innovation' and 'the learning economy' (Lundvall and Johnson 1994). Both these key elements would require significant mobilisation of the university and the public research sector generally, together with industry. This mobilisation was incentivised materially with increased research funding through the EU's Framework Program (FP) competitive funding system for the European member countries. The FP itself was a strategic instrument aimed at European political and cultural integration via the public research sector (Glerup et al., 2015; Glerup & Horst, 2014).

Between FP6 (2002-2006) and FP7 (2007-2014), funding through this pre-eminent multilateral scheme rose by $7B Euros/annum. In addition to this increased European investment, the Lisbon strategy also set a goal for member states' investment in national public research sectors to reach 3% of their GDP. At roughly the same time, a parallel process of institutional reform involving Europe's university sector was underway – the Bologna Process. Among the goals of the Bologna Process was to harmonise training standards and University cycles across member states. Taken together, the Lisbon Strategy and the Bologna Process would exert considerable supranational institutional influence on European states' public research systems, thereby promoting convergence across their motivating paradigms right through to their governing arrangements.

Climate change and other pressures for a new goal-oriented paradigm

Over time, in the influential jurisdictions of the US and the European community (which at the time included the UK), legislative and institutional changes structured the governance of public research systems to meet new paradigmatic public expectations. Some of the earliest apparent changes were funders' new appetite for discipline-bound research

practices to make room for bigger and more interdisciplinary programmatic research endeavours. These changes came in response to the recognised complexities of addressing 'grand societal challenges' – a term that would later give way to 'existential threats' and the need for 'societal transformations' in multi-lateral science policy discourse (Fritsche et al., 2010; Grand Challenges Canada, 2011; Fazey et al., 2018; Lavery, 2022; OECD, 2023a). Examples included food insecurity, non-communicable diseases and climate change were becoming apparent (Felt et al., 2013; Foray et al., 2012; Keenan et al., 2012). Thus, the advent of funding tools such as formal research networks that spanned academe, industry and government, as well as multi-disciplinary and multi-site 'Centres of Excellence' models, diversified the 'science policy mix' in most high-income nations by the late 1990s (Glerup & Horst, 2014).

As described in the introduction, the language of a new social contract for RSI was, by the early 2000s, becoming an explicit part of the discourse, especially within European science and research policy circles. Much of this early policy discourse can be traced to Helga Nowotny, now Emeritus Professor of Social Studies of Science at the Swiss Federal Institute of Technology Zurich and inaugural chair of the Research Advisory Board of the European Commission from 2001-2006. From 2010 to 2013, Nowotny held the vice-president and then president positions of the European Research Council. As an influential policy actor, Nowotny clearly drew on her own critical scholarship about the social value of research to pen influential policy positions based on the concepts of what she called 'Mode 2 Science'

(Nowotny et al., 2006).[8] In later years, European research policy would continue to be shaped by an epistemic community of elite scholars-turned-policy-makers, with expertise in the social studies of science (Macq et al., 2020).

The introduction of Mode 2 Science (or second-generation governance) as an underpinning idea to direct the EU's Framework Funding Program was a paradigmatic shift which set a new standard for how research should be undertaken in the institutionally unified 'European Research Area' (ERA, Europe's so-called "single market for research"). With some 13 billion Euros of contestable funding available annually through the FP, there was a considerable material incentive for national systems to adapt to the supranational paradigm, as will be seen in the case study of Denmark.

2.4 Establishing a New Paradigm: Institutional & Material Co-Evolution

The call from inside the European Commission for a 'Mode 2' way of conducting research emerged at a time when the institutional and material conditions were making it easier to achieve wider and more diverse collaboration in research. Institutionally, the Bologna and Lisbon agreements promoted ease of collaboration across European countries and research performing sectors (academe, industry and government). Materially, Internet connectivity was becoming an important resource. The increasingly networked scientific enterprise was enabling bigger and more ambitious projects that could harness the expertise of multiple

[8] In sharp contrast to the discipline-based practices of the physical and natural sciences, which had dominated the governance organisational structures of public research, the tenets of Mode 2 science are that it should be context-driven, problem-focused and interdisciplinary. This new way of working found early expression in the collaborative 'platform' funding instruments such as research networks and centres of excellence models.

researchers and disciplines toward finding solutions to identified problems (M. Nielsen, 2012).

While the Internet enabled researchers to collaborate in new ways, it also gave the public unprecedented access to information, albeit of sometimes variable quality and unverified credibility. This changing environment brought with it new public and government expectations of researchers to be more open about their work. Such openness could theoretically counter any emerging public misinformation, which had the potential to spread more rapidly in newly networked societies. It was also a natural outcome of Internet-enabled accessibility and funders' enthusiastic adoption of 'Mode 2' concepts, which was gaining traction globally. Thus the 'Mode 2' paradigm was further reinforced by the very technology it helped to establish.

The Internet was not the only new technology to influence the governance conditions for public research, however. New material realities, derived from research itself, were continuing to influence how research was done. Perhaps, the most influential example of this co-evolution was the US National Institutes of Health's ground-breaking Human Genome Project (1990-2003). The HGP was an ambitious research platform that would require significant funding and therefore a compelling justifying narrative. Indeed, researchers' promise of genome-based 'precision medicine' attracted government attention, but there was public apprehension about the potential ethical, legal and social implications (ELSI) of the research (McElheny, 2010). Funders and researchers therefore agreed to dedicate 5% of funding to the study of such issues. Given the quantum of money, a veritable sub-discipline in the social assessment of technology gained prominence and later matured (Balmer et al., 2016).

Work in this area led to methodological innovations in participatory and deliberative research, which in turn brought the public closer to the research endeavour. It created new engagement channels but also new public expectations of accountability (Juengst, 2021). The ELSI approach had its critics, not least among its own early adopters in the critical social sciences who opposed the emphasis on the promise of genomics over its potential critique. In this opposition, however, were the seeds of next-generation research governance which would emphasise 'Responsible Research and Innovation' (RRI) and called for an open-by-default approach at the interface between the research community and the public (Owen et al., 2012; Owen & Pansera, 2019; Stilgoe et al., 2013).

This call for transparency to maintain public trust and legitimacy echoed what was also going on in biotech more generally, through a mix of institutional and material factors. The combined influence of new scientific frontiers, IP liberalisation in the US (i.e., the Bayh-Dole Act), and the race for global economic competitiveness gave publicly-funded researchers the means and incentive to collaborate with industry. However, where industrial research agendas and practices might clash with perceived public interest or established principles, there was a need for legitimacy and accountability (Atkinson-Grosjean, 2006).

Perhaps it is not surprising that these issues first came to light within the health and human sciences, where the uneasy mix of commercial potential with human values is

apparent.[9] However, the same calls for accountability would later arise in the environmental sector and more recently in digital and data sciences.

Thus, technological advances co-evolving with new institutional settings, disrupted the conditions that once justified research community self-governance. As public research took on more overtly normative questions and practices, these blurred the boundaries and created tensions between public and private interests, ushering in a new governance paradigm in major Western research jurisdictions by the early 2010s. To promote responsiveness and accountability of the RSI sector, funders began to mandate practices of transparency and engagement, which challenged the traditional paradigm of research community autonomy. A new paradigm under the banner of Open Science was beginning taking shape (European Commission., 2014; Moedas, 2015; E. Smith et al., 2016).[10]

Crisis of trust demands new modes of legitimacy

One of the most significant policy mechanisms under the Open Science paradigm was the introduction of open access to scholarly publications. Gaining ground globally by the early 2010s, this practice shifted the costs of publication from readers' subscriptions to authors'

[9] Arguably most evident and urgent in the health and human sciences, the need for mechanisms of public accountability arose from the combined effects of new technological advances, coupled with new institutional settings that encouraged commercialisation. To safeguard the integrity and legitimacy of the sector against conflicts of interest, governments in the North America and Europe have required public and private sector researchers to register research protocols and other information about any clinical trials that are making use of public funds. This practice allows members of the public and fellow researchers to access trial information and keeps the pharmaceutical industry accountable when it uses public resources such as access to doctors or patience in the public health system (Krleža-Jerić et al., 2005).

[10] Open Science has been defined as "the practice of making scientific inputs, outputs, and processes freely available to all with minimal restrictions. Scientific research outputs include (i) peer- reviewed science articles and publications, (ii) scientific and research data and (iii) public contribution to and dialogue about science. Open Science is enabled by people, technology, and infrastructure. It is practiced in full respect of privacy, security, ethical considerations and appropriate intellectual property protection" (Office of the Chief Science Advisor of Canada, 2020)

research budgets, thereby removing the barriers to access publicly financed scientific knowledge. However, unanticipated challenges soon arose, not least the emergence of the 'predatory publication industry'. The resulting rise in spurious or low-quality journals, with poor or non-existent peer review, threatened to undermine public trust in this cornerstone institution of the research endeavour (Grudniewicz et al., 2019; Wingen, 2022).

At the same time, other new policy mechanisms of the Open Science movement began to affect the institution of peer review. Once a mainstay of the research sector's Scientific Freedom paradigm, the practice of peer review later became the focus of institutional innovation and reform. Concepts such as open peer review of manuscripts emerged, allowing anyone interested to read reviewers' comments in the pre-publication stages of scholarly manuscript preparation.

Another innovation has been extended peer review, whereby non-scientist stakeholders participate in the assessment of research in an apparent bid to ensure its public relevance (Bremer & Meisch, 2017; Funtowicz, 2006; Meisch et al., 2022). This practice has been used especially in research relating to contentious areas of public policy, where engagement of stakeholders and citizens is intended to build trust in the knowledge produced, thereby also positioning in for practical application.

In the European context, these new methods of knowledge legitimisation became part of the broad Responsible Research and Innovation (RRI) policy discourse and movement within the Commission (Owen et al., 2012; Stilgoe et al., 2013). The institutionalisation of the RRI concept and practice was assured when the European Commission made it central to its

funding programs and when its leading academics launched a dedicated journal (Glerup et al., 2015; Valdivia & Guston, 2015).

In some non-European settler societies such as Canada and New Zealand, explicit discourse of RRI is less obvious than the concerns and priorities of Indigenous people that have begun to establish a place within national science policy in recent years (Hayward et al., 2021; M. Hudson & Putaiora Writing Group, 2010; MoRST, 2007; Panel on Research Ethics, 2022). Both in terms of public research that represents indigenous interests, but also research that takes into account indigenous knowledge, a distinct type of responsible and responsive research has been developing against the backdrop of post-colonial institutions. As will be seen in the case study of New Zealand in particular, emerging indigenous academic and policy actors seized an important political window to introduce ideas about 'decolonising' RSI policy and institutional contexts (Kukutai et al., 2021). However, a common understanding of what that means for the scientific enterprise is far from established, and the concept remains controversial among some researchers (Clements et al., 2021; Stewart, 2021; Waitoki, 2022).

A third new mechanism under the Open Science banner stems from the belief that engaging knowledge-users and citizens to help shape funding programs will increase the relevance (responsiveness) of the knowledge generated. Thus, the policy mechanism of ex-ante review was introduced to help funders identify the type of research that would be most relevant to society *before* anything is funded (Brown, 2014; Fisher & Maricle, 2015). While not universally adopted and still controversial, the world's leading funders cautiously recognise the need to show more deliberate societal responsiveness in selecting research to support. (Global Research Council, 2019). The move to give prior consideration to potential outcomes of research contrasts markedly with traditional methods of organising and funding

public research activities in which elite researchers alone established the agenda and controlled the means of assessment and resource allocation.

These growing transnational trends toward government-initiated, open and deliberative processes to steer the public RSI sector have been documented by the OECD (Borowiecki, 2018; Paic & Viros, 2019). Indeed, the biennial *OECD STI Outlook* for 2018 was the first time in the series' history that the OECD chose to highlight the systemic changes in organisational arrangements and funding tools aimed specifically at societal engagement (openness) and addressing societal challenges (responsiveness) (OECD, 2018).

Influence of supranational actors

In drawing attention to the shift toward openness and engagement in research governance, the OECD was not just a rapporteur but an agent of change. The legitimacy and authority of the OECD in research and innovation policy advice, and the implicitly competitive benchmarking and comparison exercises that it has institutionalised since the 1960s, are highly influential with member governments. Most states are keen not to be seen as policy laggards (Key informant interview).

Indeed, a 2019 OECD comparative analysis of research system governance modes and policy instruments indicated that 91% of member states had recently launched major strategies and instruments to address societal challenges and engage publics – and this was even before the Covid-19 pandemic provided a vivid illustration of their utility (Paic & Viros, 2019). Thus, the OECD's shift from measuring and comparing RSI policies and instruments aimed mainly at economic competitiveness, to include RSI policies and instruments for civic engagement and societal challenges, underscores not only its global role in policy diffusion and alignment, but also the nature of the new paradigmatic trend that it is helping to define.

The timing of this shift in OECD discourse is significant. The 2018 *STI Outlook* report captured changes to governance and policy instruments from late 2016. This was shortly after the UN had launched its 2030 Agenda to achieve the Sustainable Development Goals (SDGs) (United Nations, 2015). In tandem, the UN established the Technology Facilitation Mechanism (TFM) (UNEP, 2015)and other multi-lateral advisory groups with an early mandate to help align national science and technology policies and funding so as to contribute *collectively* to research that would advance the SDGs. To this end, in 2016 the inaugural UN STI Forum assembled the world's national research funders and science bodies to work towards coordinating national and supra-national research policy and funding approaches.

The STI forum established an unprecedented global research governance institution that bridged national and global regimes. The SDG framework, for its part, provided a unifying interpretation of social responsiveness and accountability across RSI systems. They worked together to establish a shared set of aims and practices to which all national public research and innovation systems should strive to align. As an influential multi-lateral policy actor, the OECD was helping to institutionalise this new paradigm by moving beyond its usual indicators of RSI sector success, which had been grounded in publication metrics and economic indicators, such as commercial patents. Now, it was also mobilising the discursive power of measurement and comparison to help compel member states to institutionalise new coordination structures and to adopt collective aims in public research systems[11].

[11] The OECD's role in reinforcing the discourse of the UN SDGs is significant because it specifically engages affluent nations in sustainable development, where there has been a prevailing assumption in the past that UN programs are mainly focused on Low- and Middle-Income Countries (LMIC).

Other international organisations also played key roles in institutionalising the paradigm of social accountability and responsiveness of public research. For instance, the European Commissioner for Research Science and Innovation led a process of consultation and co-design to develop the next FP for research funding (2021-2025). To help frame the FP's research missions, Marianna Mazzucato was brought in by the Commissioner. A well-known economics and innovation scholar, her previous work had influenced bids for a proposed Green New Deal during the US election campaign of 2020. In Europe, Mazzucato's input informed the final slate of FP thematic research 'missions' including climate change transitions, carbon neutrality, the food-land-water nexus, all of which were underpinned by inclusive and transparent practices of research (J. Roberts, 2018).

For its part, the International Science Council took a leading role in global science diplomacy too. As a transnational policy actor, the ISC promoted culture change among its member scientific bodies to take up societal challenges and to better coordinate the major research policy questions within their sphere of influence at national levels. The overarching goal was to shape a common interpretation of national public research systems to better align with the societal transformations needed to achieve the SDGs in a way that would foster both integrity and transparency of research practice. The evolution of science diplomacy is a research topic unto itself and is beyond the scope of this thesis. However, at least recognising

the sustained policy engagement of high-profile elite researchers in the international arena is nonetheless important.[12]

Tension between transnational and national governance perspectives

From the research governance perspective, the focus on the societal responsiveness of the RSI sector could be seen as a continuation of the so-called Impact Agenda that had been growing since the early 2000s, with governments demanding more obvious return on investment from public research (Hessels et al., 2009; Wilsdon et al., 2015).

Yet, a profound shift was occurring in the interpretation of impact. At the global level at least, the discursive emphasis was moving from a narrow focus on commercialisable innovation for economic growth as the key measure of social impact toward meaningfully

[12] The topic of elite international science policy actors and their discourse of 'science diplomacy' is well beyond the scope of this thesis. Yet they have played a role in exerting exogenous ideational influence on domestic public research systems, so some flexibility in footnote conventions might be called for. While there have been a variety of interpretive definition of science diplomacy over the years (P. D. Gluckman et al., 2017; Royal Society & AAAS, 2010), with the launch of the SDGs in 2015, the concept and its practices have evolved. It broadened away from its roots as a largely state-led activity that either used scientists to promote state interests (track 2 diplomacy) or engaged diplomats to promote the interests of national research sectors in the international arena. By 2015, science diplomacy firmly included multi-lateral and non-state actors engaged in developing the collaborative discourse needed to align national research governance strategies and priorities toward the SDGs and climate challenges. Influential non-state science policy actors have co-developed these science diplomacy roles since 2015 to seed an international discourse that has shaped a new interpretation of the role of national research governance and its linkages at the international level in the SDG era. Dedicated journals, conferences, capacity development workshops, funding calls and joint publications in scholarly and policy venues have helped institutionalised this discourse.

Actors developing this global discourse are strategically positioned and, significantly, they are collaborative in their efforts. They know one another and work through integrating structures such as the International Science Council, the International Network for Governmental Science Advice (INGSA) and its sub-network, the Foreign Ministries' Science and Technology Advisory Network (FMSTAN), both of which were jointly developed by elite scientist-turned-international-policy-entrepreneurs who had worked together in other contexts. Some of these key elite individuals include: Bill Colglazier, former Chief Science Advisor to the Secretary of State and is successor Vaughn Turekian, now the Director of International Science at the US National Academies, Sir Peter Gluckman, the inaugural Chair of INGSA and the President Elect of the ISC, Heide Hackmann, the former Executive Director of the ISC, David Mair, Head of Unit for policy advice in the European Commission's Joint Research Centres, James Wilsdon, Scientific Director of Wellcome Trust funded Research on Research Institute (RoRI), Jan-Marco Muller, Director of International Affairs at the International Institute for Advanced Systems Analysis and recently returned to the European Commission in a new Role for Science Diplomacy, Romain Murenzi, Director of The World Academy of Science and providing training in science diplomacy, Mona Nemer, Chief Science Advisor to the Government of Canada, and members of the Horizon 2020 funded 'Science for/in Diplomacy for Addressing Global Challenges' (S4D4C) program.

addressing the existential threat of climate break-down and the pervasive impacts of digitalisation. And with the recognition that these are highly complex problems of collective action, a parallel discursive shift was taking place in knowledge sector, from the discourse of competitiveness toward collaboration (OECD, 2020).

However, it was apparent that the relative national uptake of these global-level discursive shifts was at least partially dependent on existing interpretive frameworks (paradigms) in use at the national level. In some small countries, for instance, the economic framing of the social purpose of research is often prevalent (as discussed in Chapter 1). However, distinguishing the effect of ideology is also important (Flink & Kaldewey, 2018). States with strong dedication to a paradigm of market-oriented governance not only tended to maintain a focus on competitiveness and innovation, but also gave less emphasis to the role of research in addressing climate challenges. Indeed, “neoliberal governments have great difficulty in coming to terms with climate change because it requires a lot of intergovernmental cooperation and major collaborative action that doesn't fit in with the neoliberal model.” (P. Rogers, personal communication, 2020).

Fundamentally these are differences of perception about the social purpose and value of research, with material effects on how research is organised, governed, and ultimately, on the kind of knowledge that is produced, or not produced (Croissant, 2014; Proctor, Robert & Schiebinger, Londa, 2008). Such differences are undoubtedly set to become even more pronounced globally, as the full impact of the Covid-19 pandemic – not to mention concurrent challenges of climate breakdown, demographics and digitalisation, all come into focus.

2.5 Summary

This high-level historical overview of the evolving interpretations of the social contract for public research as an RSI governance paradigm, demonstrates first how the epistemic values of the research community came to be supplanted by more explicitly normative social values. This shift in emphasis shaped the public research governance paradigm within the globally-influential regimes of the US, UK, Europe and later, the UN and the OECD (S. Maasen & Dickel, 2019). Yet, the paradigmatic shift in RSI governance, which sought to make the sector more responsive to societal needs, has also opened it up to contestation about exactly which (and whose) values to prioritise and how. The response to this question is largely determined by states' institutional, material and ideational (including ideological) contexts and histories. However, supranational pressures to coordinate in the face of unprecedented collective action problems are stronger than ever, all of which makes the paradigm appear even more unstable.

Summarising the general shifts in RSI governance according to evolving perceptions of its purpose (Arnold & Barker, 2022) posit what they call three broad "governance generations," which can be considered paradigms:

1. First-generation science governance, which privilege the epistemic authority of the largely autonomous research community;
2. Second-generation governance, which drew heavily on the epistemic influence OECD and focused on science output to serve 'national systems of innovation' building competitive economies;
3. An emerging third-generation governance aimed at aligning national research systems for the collective global effort of largescale societal transformation for resilience and sustainability.

While this three-generation model offers conceptual elegance, it overlooks important nuances within each generation or paradigm. These nuances correspond to distinctive periods of significant change in policy logics and instruments, and their frequency reveals the paradigm's relative instability. Thus**, table 2** (below) summarises a more detailed evolution of public research governance paradigms, based on the four key identifying features found in the literature, and showing the distinctive periods these reveal (Kern et al., 2015; Skogstad & Schmidt, 2011).

With this global background, the remaining chapters in Part 1 lay out the conceptual framework and analytical tools of this thesis. They will be used to identify and understand evolving policy logics, instruments and actors that could indicate paradigm in/stability and the impact this has on national research governance regimes of New Zealand and Denmark.

Table 2: Generalised evolution of the public research governance paradigm, classified by four characteristic features

RSI Paradigm (Theorised in Lit.)	Distinctive period		Rationale / Perceived social purpose	Policy objectives and thematic priorities	Operational arrangements	Key actors and roles
1st Generation governance paradigm (Scientific Freedom	**1918-1939** Nation-building and growth	Settler states	Generating knowledge for primary sector industries	Agriculture, natural resources; Few universities are research intensive	Agencies established to fund and perform research (e.g., geological survey; agricultural research for new environments; indus. R&D)	Departments of food and agriculture, of mines; Industrial development agencies; National research councils
		Europe	Interwar years of national industrial development	Industrial development; knowledge advancement; classical disciplines	Industrial foundations lead research funding. Systems of technical colleges and specialised universities (physical sciences and engineering) to develop capability and industrial capacity	Industrial foundations, specialised technical colleges and research universities, patent offices.
	1939-1945 War effort	Settler	Supporting war effort for colonial powers	Defence technology; medicine; nutrition, food processing and storage; social sciences (anthropology, sociology, psych.)	Agencies adapt their mandates for war; civilian and defence collaboration; social sci. instrumentalised	Depts of Defence, of Health, Universities, National research councils, government offices of R&D
		Europe	War time research and development, both sides	Wartime defence; medicine nutrition and food processing; computational research; information tech.	Nationalised industries for defence R&D, both sides	Nationalised industries (Germany); Universities and PROs (UK)
2nd Generation Governance paradigm (government -led, competitiveness-focused)	**1946-1989** Big science and scientific freedom	Settler	Supporting Cold-war preoccupations followed by emergence of peacetime R&D for innovation (space, nuclear, ICT, Biotech)	Defence tech; space race; energy security; ideological counterpoint to government-directed research in Soviet bloc.	Certainty of long-term public funding and minimal government involvement; Invest in 'Big Science' infrastructure; Advent of OECD advice	Departments of Defence, of Industry; National research councils, medical research councils
		Europe	Recovery, Cold-war, Western European integration, industrial development	Knowledge based manufacturing (chemical, pharmaceutical, instrumentation)	Post-war institutional development for multilateralism (e.g., UN CERN, IIASA etc.)	Common European market development; Multilateral institutions; Industrial foundations
	Late 1980s to early 2000s Globalisation and the 'new economy'	Settler	Post-Cold War focus on 'competitiveness' and 'innovation' for a globalised 'new economy'	Biotech; ICT; networked research; industrial R&D distributed across globalised value chains	Public-private partnerships; 'entrepreneurial' universities; tech transfer offices in academe; research networks and platforms; formalisation of science policy expertise (to monitor, incentivise performance); performance-based funding	Ministry of Higher Education, of industry, of science and innovation (either stand-alone or combined with industry), Universities; 'research parks,' public-private partnerships
		Europe	European integration and	Development of common higher education market	Emergence of European Commission framework funding programs; bulk	Like setter states, but also increasing role of supranational European

2nd Generation Governance paradigm (government -led, competitiveness-focused)			community building.	(Lisbon and Bologna processes)	funding to universities (later performance based); industrial parks; Joint Research Centres of European Union, multilateral research centres	government in RSI policy influence (through funding program, and harmonised higher education standards)
	Mid 2000s to 2015 The 'New Social Contract' discourse	Settler	Emergence of the 'Impact agenda' distinction of 'impact' (economy, society, environment); and 'excellence' (merit-based, science-driven assessment)	Focus on 'societal challenges' alongside 'innovation'; New discourse of 'relevant', 'responsive', 'responsible' 'end-user engagement'; Open science agenda for transparency, innovation, includes explicit concern for ethics of research with indigenous peoples	Impact and 'return on investment' are monitored and incentivised; Public funders use 'fund & follow'	Ministry of industry, of science, of Higher Education (sometimes combined with science); Diversified national funding councils; Private sector; Transnational funders policy agenda-setters in multilateral community (esp. around climate change)
		Europe	Emergence of Responsible Research and Innovation discourse	Similar themes to settler states but Indigenous issues replaced by concern for European integration and social cohesion	Framework program introduces large network mechanisms to address "Grand Societal Challenges" (from 2009)	EU Research directorate (begins formal RSI system reviews); multilateral community (launches SDGs and refocuses Euro attention on Paris climate summit after failure to reach agreement)
Emerging 3rd Generation governance paradigm (co-design, collective challenges, global perspective)	**2015 - 2020** STI for SDGs Societal transitions through Open / Engaged Science	Settler	Emerging emphasis on research to support shared challenges and interacting societal transformations as in the SDGs (i.e., digitalisation and decarbonisation)	More policy for research: Open data, publication integrity, public engagement, diversity of research workforce. More centrally planned national research strategies to better align policy sectors on societal transitions	Research platforms institutionalise 'Frame, fund & follow' model; Alignment of funding horizontally (across sectors and disciplines), vertically (national to global goals)	Same as above with addition of greater multilateral influence: UN SDGs, IPCC, EU; Private sector (esp. data analytics)
		Europe	Societal Transformations. Broader understanding of innovation, beyond economic and competitiveness framing.	From "Open Science, Open Innovation, Open to the World" to "Green New Deal"	Green New Deal planning for the Horizon Europe Framework funding, unprecedented supranational coordination was required, with binding commitments from member states.	New EU Commissioner for Science was willing to be very directive by 2019. 'Frugal Five' dissenting states initially opposing the high cost of entry into Horizon Europe funding scheme
	2020 onward Post-Covid 'Science to Build Back Better'	Settler	Post-covid-19 resilience and recovery. Addressing global existential threats (use of more urgent language)	Transdisciplinarity, Open science, more transnational coordination of research strategies	TBC. Greater role for transnational and multilateral agencies?	TBC. Global Funders Forum (collective action by national funders and global philanthropists to incentivise national alignment and public interest research?
		Europe	Post-covid-19 resilience and recovery, social cohesion, European stability (use of more urgent language)	Coordination across member states; Green Deal objectives; Addressing Russian aggression and safeguarding science relationships	TBC. Coordination across member states; Science diplomacy (protecting refugee scientists and suspending science relationships)	EU Commissioner for Science; member state science ministers; multilateral community

Chapter 3 Theoretical Underpinning

> *The first and most fundamental requisite of any scholarly contribution – from any sophisticated epistemological stance – is to highlight one tale among the many that could be told.* (Parsons, 2015)

The preceding chapter set out the evolving global context of public research governance regimes, which has been influenced by large research-intensive jurisdictions like the US, the UK and the European Union. In turn, this global context can be expected to influence smaller research systems based on both *epistemic values* (e.g., the reliance on the international research community of peers to legitimise knowledge), and *social* values (e.g., the need for coordinated research to help protect the global commons). The chapter also showed that new expectations about social accountability and responsiveness have given rise to policy tensions (S. Maasen & Dickel, 2019). These tensions are assumed to be more evident in smaller, systems such as New Zealand and Denmark, where material resource constraints might demand more acute prioritisation decisions about what 'socially responsive' research might mean in practice.

The current chapter now lays out the conceptual framework that guides the examination of these tensions within the case studies. It will show how they resolved into an identifiable governance paradigm (however temporary) through processes of institutionalisation of ideas (Hay, 2017), which are themselves mediated by structural legacies and material interests (Blyth, 2016; Blyth et al., 2016). In developing the framework, any number of theoretical positions that foreground different influential factors could have been adopted (Parsons, 2015), but the position used here is based on a contemporary understanding of constructivism. That is, it is post-positivist and holistic, but it rejects the

ultra-relativism of late 20th century post-modernism. Ontologically, the conceptual framework challenges the notion of static, objective, independent causal factors, and focuses instead on the explanatory power of their interaction and the way they are interpreted by actors. As such, the theoretical aim is not to typologise the RSI governance regime according to supposed modes of governance (Capano et al., 2015). Rather, it is to view the regime as a dynamic, politically contingent, and contextualised social construct, and the result of multiple interacting, often interdependent influences at both national and global levels. Institutions are acknowledged to have a constraining influence (if not exactly stabilising, as will be shown). However, they are not viewed as structures to take for granted, but as paradigmatically driven constructs to be examined.

Within political sciences, this approach is most closely aligned with theories of Discursive Institutionalism (Schmidt, 2008, 2012, 2017) and Constructivist Institutionalism (Hay, 2008, 2016b). While both DI and CI are sociologically influenced neo-institutionalist approaches, CI is more attentive to actors making sense of their contexts while DI focuses more on the discourses they produce, as constitutive or reinforcing of institutions. Given these distinctions, it is primarily CI that informs this thesis.

In drawing on this form of constructivism however, the thesis departs from the harder line of this position by nonetheless acknowledging the influence of structural legacies, both material and institutional. It therefore leverages the mechanisms theorised by Historical Institutionalism, while reframing these from a constructivist perspective (Blyth et al., 2016; Campbell & Hall, 2009). The following section lays out how this hybrid framework was developed by weighing up the strengths and weaknesses of the range of neo-institutionalist models.

3.1 New Institutionalist Explanations of Change in Public Research Governance

New institutionalist (or neo-institutionalist) theories in political and policy studies emphasise the influence of structure to explain policy-making outcomes or the shape of a governance regime. Arising in the mid-1980s, neo-institutionalism developed in reaction to the analytical influence of economics on policy, which viewed political (collective) phenomena simply as the aggregate of individual utility-maximising choices. By contrast, neo-institutionalism gave more consideration to the influence of structural forces in the form of institutions.

The label 'new' was attached to distinguish and broaden the definition of an institution, beyond the formal structuring devices such as legislatures, courts and executives. Neo-institutionalism understands institutions as "collections of interrelated rules and routines that define appropriate actions in terms of relations between roles and situations" (March & Olsen, 1989). In other words, the definitive attribute of an institution - whether formal or informal - is the regular pattern of behaviour it produces, which endures over time (Cairney, 2019).(Blyth, 2016; Blyth et al., 2016) The structuring influence of institutions is therefore presumed to provide stability within a governance regime. But how they do this, is a point of ontological debate in the literature.

For instance, rational choice institutionalists, assume that (utility-maximising) behaviour is constrained by institutions, which in turn are taken for granted as objective and often codified rules, laws and standard operating procedures. For sociological institutionalists, it is cultural norms and practices that constitute the 'rules of the game' that structure actors' choices, though these too are presumed to be static and immutable. Historical institutionalists take a process-oriented view that assumes path dependencies and

policy legacies become institutionalised and structure subsequent action in a fairly linear and predictable way (Blyth et al., 2016).

In explaining the shape of public research systems, institutionalist accounts have tended towards a rational-choice perspective, apparently as the default tool applied to a redistributive policy aimed at producing a public good (Flanagan & Uyarra, 2016). Recently, a more sophisticated view of public RSI governance has turned to Historical Institutionalism (HI). It takes into account the sector specificities, especially the slow moving and cumulative nature of scientific research, its unpredictability and therefore the impossibility of perfect information on which to make a rational policy choices (Aagaard, 2017; Aagaard et al., 2016).

A central concept in HI to explain institutional stability is 'path dependency' whereby the effects of past decisions affect material conditions which in turn set the course for subsequent policy options by making some paths more attractive while foreclosing others. As the name suggests, path dependency is a useful concept to explain stasis and stability through the influence of established patterns.

HI theorists classically employ a different concept to explain change. The influence of exogenous events such as elections, or 'shocks' such as major financial crises, war, natural disasters, pandemics, etc., are assumed to break the path dependent stability of a regime. Significantly, this reliance on exogenous shocks as causal mechanisms has tended to align HI with the materialist rational choice theories of economists rather than an explanation resting on politically contingent interpretation by actors (Blyth, 2016). Overall, the main thrust of HI analysis has been to show how institutions – established through path dependencies – constrain and structure actors' choices.

More recently, the so-called second wave HI sees change as rather more incremental (Chou, 2016). Without denying the influence of exogenous shocks, there is now also a recognition of a more continuous evolution led by incremental endogenous processes for which four mechanisms have been theorised (Mahoney & Thelen, 2010; Streeck & Thelen, 2005). The first mechanism is 'displacement', which describes the cumulative change within an institution that takes place incrementally over time. The second is 'layering', whereby new rules are imposed on top of or alongside existing ones, sometimes as a result of changes in partisan control that nonetheless lack resources to make profound change. The third mechanism is 'drift', whereby institutional rules may change in response to evolving contexts and the resulting policy behaviour will drift in a new direction. Finally, 'conversion' sees existing rules and structures are deliberately deployed in new ways to suit new conditions.

In both its older and more recent variants, HI privileges the influence of structure over agency to explain policy-making or to account for the shape of a governance regime, which it sees as generally stable. To the extent that HI considers the active role of policy agents, it is most often aligned with materialists' concepts of rational choices driven by supposedly objectively held interests (Hall, 2015; Schrad, 2010).

In the research governance literature, HI concepts such as path dependency and layering have been used to account for enduring national specificities in training and funding allocation models despite the strong transnational and multilateral influences on national research systems. The different ways that public research institutions consolidated in different countries after World War 2, for instance, have been shown to have lasting effects (Bonaccorsi, 2015).

HI concepts have also been used to show how structural changes can be brought about by incentivising researchers' behaviour where national research-funding practices are competitive. This is seen, for instance, in the performance-based research governance modes that gained prominence from the mid-1990s. Governments use "carrots and sticks" to enlist and shape the interests of the supposedly autonomous research community, in order to meet government-defined priorities (Lewis, 2015; Rip & Van der Meulen, 1996).

HI has also been used to explain the evolution of national research funding priorities. That is, where funding is more predictable and where funded research meets the perceived standards of quality (typically through peer review systems established nationally), it leads to more funding success, thereby creating areas of national expertise or recognised 'sovereignty niches' (Glod et al., 2009; Thorhallsson et al., 2018). An HI explanation posits both interest-based and layering effects in this case, as elite researchers become influential within the policy regime and seek to perpetuate the conditions of their success thereby entrenching niche research areas (Stephan, 2012). Sociologist of science, Robert Merton called this the "Matthew Effect in Science", but it also can be seen as a kind self-reinforcing path dependency (Merton, 1968).

In Denmark, HI has been applied to explain the public research governance regime moving from a stable system to a complex multi-tiered system with many new policy mechanisms. Kaare Aagaard draws on the updated HI concepts of endogenous change to suggest that layering and displacement processes have led to minor policy changes over time that in turn have brought about significant modification of the overall governance regime (Aagaard, 2017). Coupling HI with rational choice mechanisms, Aagaard theorises the causal power of actors' interests within the governance regime. The resistance to change and protection of interests by elite researchers in the National Research Council came as the

Ministry of Higher Education sought greater directional control of the sector. According to Aagaard, ministry officials managed to circumvent scientists' resistance and to force institutional change through policy layering and the creation of new policy venues to diminish the influence of the national council.

An HI explanation may therefore show that material conditions, path dependencies and the gradual mechanisms of change all play a role to shape public research governance regimes, but it fails to give the full explanatory story. One problem is that most HI accounts of policy or governance regimes tend to focus on the state and its stable institutions as primary explanatory factors (Farrell & Finnemore, 2016). Yet as previously discussed, in the past two decades, transnational and multi-lateral organisations have become among the most significant drivers of change within national public research governance regimes (Borrás, 2019; Borrás & Radaelli, 2011; Henriques & Larédo, 2013a; Lepori et al., 2015).

Better explanations would draw on multi-level governance theories (Doern et al., 2016; Hooghe & Marks, 2003), on the processes of policy diffusion (Dolowitz & Marsh, 2000; Simmons & Elkins, 2004), and on the transnational spread of ideas in the form of a new policy making paradigms (Carstensen, 2015; Daigneault, 2015; Porter, 2011; Schrad, 2010; Skogstad & Schmidt, 2011). Such approaches attend to the fact that the uptake of transnational ideas relies on how they interact with the domestic conditions that mediate how they are interpreted and made sense of by domestic actors. For instance, domestic actors' must have a favourable interpretation of incoming policy goals and ideas, and the domestic institutional conditions must allow for incoming ideas to become embedded "in a manner that suits the traditions of the political and administrative context" (Borrás & Radaelli, 2011). Indeed, (Braun, 2006b) found that evolving global public research paradigms do not act directly on

domestic ones, but instead "manipulate the environment of local action" by *influencing the local criteria* by which an idea or goal is judged to be legitimate. Thus, could such explanations, more so than simple path dependency, explain why some European countries still have not taken up the policy instruments and governance modes that are favoured by the European Commission to promote accountability and responsiveness of public research?

For instance, in a survey of thirty-three European countries, Niels Mejlgaard found major East-West differences in implementing new programs around public engagement in science and funding for 'societal challenges' that are characteristic of the current 'accountability and responsiveness' paradigm (Mejlgaard, 2017). Lepori and colleagues had similar findings of the persistence of national governance paradigms, particularly in Eastern Europe (Lepori et al., 2009). Yet, for such countries rebuilding national public research regimes in the wake of communist collapse, HI's concept of path dependency is not a likely explanation. Instead, the reluctance to adopt the Commission's public research governance ideas may be more about their perceived lack of legitimacy according to local policy goals and the dissonance with structural (material and institutional) conditions.

A second problem is that HI – even in its updated variant – does not easily recognise the influence of the informal institutions of non-state actors. It tends to assume instead stability of codified rules (Blyth et al., 2016; Cairney, 2013; Peters & Zittoun, 2016). This assumption misses the tacit yet long held institutions[13] that are unique to the research sector, in which it is the non-state actors who seek to maintain stability and predictability and to ring-

[13] Examples of such institutions include training that socialises students into the practice of research; the importance of cumulative knowledge; the importance of a community of peers, among others.

fence their practice from government (Gieryn, 1983; Guston, 2001; Vinck, 2010).[14] Without attending to the institutionalised norms and behaviours of non-state policy actors, this explanatory factor would go undetected.

Clearly the theories and concepts of HI have useful explanatory power, but these concepts alone cannot fully account for the evolving nature of public research sector policy-making and governance regimes, yet we know that institutional legacies are nonetheless a significant explanatory factor.

The next section therefore draws on ideational scholarship to add to the picture, leading to an historically sensitive constructivist theory of the research policy regime, which is laid out in the closing section.

3.2 The Third Wave of New Institutionalism

The foregoing discussion of HI redirects it toward the ideational influences that it increasingly uses to theorise mechanisms of endogenous change, despite its apparent reluctance toward constructivism (Hall, 1993; Streeck & Thelen, 2005). For instance, it has been suggested that the standard HI mechanism of policy conversion actually is prompted by actors' new interpretations of (i.e. ideas about) institutional rules and contexts (Blyth, 2016; Blyth et al., 2016). This perspective is in keeping with what Chou has called the Third Wave of policy sciences. This wave encompasses work that seeks to show which policy ideas have gained

[14] Arguably, it is somewhat unique to the public research sector that the call for status quo and as little change as possible comes from outside government. Given the history of self-governance of the sector, it is government which often agitates for regime change, while the research community seeks to maintain the certainty of status quo.

political currency, including by bringing about policy isomorphism internationally - that is, similar institutional structures despite arising in different contextual conditions (Chou, 2016). The political power of ideas, Chou argues, is linked to conditions and contexts – social, political, institutional, material – in which they gain currency. At the same time, instances of ideas failing to gain currency or taking longer than international isomorphism would suggest, are just as revealing (Benner, 2018; Chou, 2016).

For instance, in a seemingly classic case of HI's policy conversion, Mads Sørensen and colleagues show how key public research policy concepts have shifted meaning over time to suit new contexts or emergent governance paradigms. They demonstrate that the funding criterion of scientific excellence (in contrast to the criterion of societal relevance) was once equated with investigator-led research under the Scientific Freedom paradigm. Now, while the label remains, the authors argue its meaning has shifted to meet the expectations of a new paradigmatic context. Aligning with a more performance-driven governance paradigm, 'excellence' as it is used in the national policy statements surveyed, has come to mean specifically "research that will lead to scientific breakthroughs" (Sørensen et al., 2016). HI would explain the phenomenon of changed-meaning through policy conversion, however, more nuance Third Wave scholarship suggests that conversion does not come about on its own. It requires new shared interpretations by actors – often deliberately framed and promulgated – to motivate action for institutional change. In other words, Third Wave scholarship acknowledges the important influence of actors' sense-making in context.

In a similar way, HI's concept of path dependence can be reformulated as an ideational rather than material mechanism. For instance, what Berman has called "cognitive lock-in" is driven by deeply held ideas (both causal beliefs and normative values) that interact with

particular institutional settings (Berman, 1998). In public research governance, for instance, we can hypothesise the impact of cognitive lock-in at play through OECD influence on national public research policy regimes (Doern et al., 2016; Henriques & Larédo, 2013a). That is, the OECD has no real power of enforcement beyond persuasion, comparison and peer pressure, yet members are compelled to follow its policy recipes the point of convergence.

Similarly, the research community has no legislative or material way to influence the direction of policy decisions or the shape of the governance regime, but it can draw discursively on a set of influential ideas to help ensure that policy makers consider its needs. For instance, arguments from the research community such as the necessity of protecting 'frontier' or 'curiosity-driven' research to create the right conditions for 'breakthroughs to occur from the unexpected,' are intended to influence governance by promoting both researcher autonomy and long-term, undirected funding (Doern et al., 2016). The research community mobilises discursively (Hay, 2017; Schmidt, 2017; Zittoun, 2009, 2015) to build its policy coalition of influence (Sabatier & Jenkins-Smith, 1993).

This is not to deny the likely influence of material path dependency on the shape of national research systems. Indeed, the sunk costs of scientific infrastructure and the latency of research outcomes dictate that path-dependent policy-making is unavoidable, as the following case studies demonstrate. However, the fact that frontier and curiosity-driven research, were perceived to need protecting for instance, demonstrates evolving perceptions of the social value and purpose of public research, which shape its dominant governance paradigm.

The concept of a dominant sectoral governance paradigm is central to the constructivist explanation of change in RSI governance regimes developed in this thesis. However, here it is not used exactly in the way that 'paradigms' were first introduced to the policy sciences by Peter Hall, deriving instead from practice and aiming to inform it.

Hall's concept of paradigms (transposed from Kuhnian philosophy of science) was intended to counterbalance the prevailing emphasis on interest-driven rational choice theory within the epistemic communities across public policy sectors at the time (Hall, 1993). Hall defined the over-arching policy paradigm as an interpretive framework that influences the ways in which problems are perceived, goals are set, and policy solutions are identified. According to Hall, such frameworks are embedded in institutions, where they are taken for granted and "unamenable to scrutiny."

Yet, defining paradigms in this way assumed that institutions are objective, independent and stable. In other words, Hall did not contemplate the mutability of institutions themselves, focusing instead on empirically identifying paradigm shifts. Nor did Hall consider the possibility of co-existing and competing paradigms as Hogan and Howlett had suggested just over decade later (Hogan & Howlett, 2015).

In the RSI sector, institutional dynamism (e.g. changing research assessment practices or constitution of university governance), and contested perceptions of purpose suggest destabilising elements in the underlying paradigm. Thus, departing from Hall, the analytical challenge here is not to determine when a fundamental paradigm shift has definitively occurred, but rather to understand what would destabilise an otherwise self-reinforcing paradigm. What triggers competition and changes in the underlying shared understanding

and practices within a sector that in turn re-orients the institutions of its governance regime (Blatter & Haverland, 2016)?

Such analysis considers the sector-level paradigm to be more politically and contextually contingent than Hall might have theorised. The dynamics of contestation, destabilisation and institutionalisation are thus shaping a new line of enquiry within the Third Wave of policy studies (Blatter & Haverland, 2016; Capano et al., 2015; Chou, 2016).

In turn, understanding that these dynamics are at the heart of governance regimes opens up a new range of explanatory possibilities to account for the shape of the regime (Daigneault, 2015). It also broadens the analytical scope to reinterpret the public research sector as more than a strictly treasury-based technical policy sector to view it as a public policy sector with significant policy interdependencies, used by governments to achieve their broader public policy goals (Benner, 2018; Benner et al., 2022; Mattsson & Benner, 2022). Thus the political nature of public research governance is revealed, rather than remaining hidden as it would in rationalist accounts or explanations based on path-dependency (Flanagan & Uyarra, 2016).

The next section takes up this third-wave and develops the constructivist analytical lens used in this thesis. This lens recognises paradigms as shared interpretative frameworks that *both shape and are shaped by* material and institutional contexts. It considers these contexts to be co-evolving as it is continuously interpreted and made sense of by policy actors rather than being an objective and fixed arena of interests (Borrás & Seabrooke, 2015).

3.3 Constructivist Institutionalism: Toward a Nuanced Conceptual Framework

Within New Institutionalist scholarship, the social constructivist approach has been taken up under the banner of Constructivist Institutionalism (CI) (Blyth, 2016; Hay, 2008, 2011, 2016c). CI posits a commonly-held interpretive framework (a paradigm), through which contextual information is made sense of by actors. The paradigm shapes and is shaped by context in an iterative and mutually reinforcing way. Structuring institutions are therefore seen as dynamic constructs rather than stable and taken for granted. Institutions both structure paradigms and are structured by them in an interdependent and co-constitutive relationship. That is institutions are influenced by a dominant paradigm that establishes and reinforces their operating procedures and authority. In turn, institutions constrain and structure by legitimising some ideas, rejecting others and controlling access to strategic resources (be they material resources, influence, or ideas) needed by actors to transform their contexts. Thus, the institutions of a governance regime follow a path dependent trajectory that is as much ideational as it is material (Gofas & Hay, 2009; Porter, 2011).

Such is the dynamic equilibrium between a paradigm, institutions and material contexts that maintains the stability in a governance regime. Daigneault (2015) theorised that this stability holds until one of two situations eventuate. Either the internal alignment

between cognitive and normative ideas[15] within the regime's dominant paradigm is shaken, or the paradigm no longer resonates with its broader context (Daigneault, 2015). These events may be due to deliberate contestation by actors or to material changes in contextual conditions such as external shocks. Both cases result in the loss of legitimacy of the paradigm, which opens it up to destabilisation and replacement (Braun, 2006b). In other words, "so long as these commonly held understandings hold firm, one can expect little in the way of sudden policy change. However, "when policy images[16] begin to falter […] the unanimity is broken, permitting drastic policy changes" (Schrad, 2010).

Therefore, the first analytical aim of CI is to understand the dynamics of how such interpretive frameworks are established and institutionalised. Colin Hay has articulated this aim in the following way:

> […] to identify and interrogate the extent to which, through processes of normalisation and institutional embedding – established ideas become codified, serving as cognitive filters through which actors come to interpret environmental signals. (Hay, 2011)

The second analytical aim is to uncover how such interpretive frameworks come to be destabilised and replaced, thereby bringing about the kind of institutional change that can reconfigure a whole governance regime within the RSI sector. In other words, what triggers

[15] Hall's original formulation did not specify that paradigms comprise both cognitive and normative ideas held in common by actors. This detail is important, however, considering that it is a misalignment between commonly held values (normative ideas) and new knowledge (cognitive ideas) that is seen to trigger paradigm destabilisation through loss of internal coherence and therefore loss of credibility/legitimacy. This rupture opens up the possibility of transformative changes to the governance regime (Daigneault, 2014).

[16] 'Policy images', 'policy frames' and 'paradigms' are among the terms that have been used by ideational scholars to mean 'commonly held ideas' about a policy issue. The diversity of terms for arguably the same concept is a challenge in the literature (Cairney, 2019).

the destabilisation and internal misalignment or contextual dissonance of a dominant sectoral paradigm, even when both material and ideational forces of path dependence appear strong (Daigneault, 2015)?

For instance, Science Policy scholar Dietmar Braun explains that the Scientific Freedom paradigm failed to deliver on public expectations of science in a new globalised political-economic context. As such, the paradigm lost its governance legitimacy in a changing material context. Policy makers seized the opportunity to challenge the credibility of the paradigm and began replacing it discursively and materially through new policy instruments (Braun, 2006a; Waldorff, 2013).

Beyond the changing context however, Braun did not examine the regime dynamics leading to the perception of paradigm inadequacy. Here, the lessons from HI must now be brought to bear. In fact, this loss of legitimacy was incremental, as policy actors developed and promulgated new ideas that they deemed better suited to the changed material and broader institutional contexts (Blyth, 2016; Streeck & Thelen, 2005). But change also can be triggered abruptly due to new interpretations of context following external shocks (Baumgartner & Jones, 2010; Jones & Baumgartner, 2007). The Covid-19 global pandemic is the most significant shock in the history of today's highly diversified RSI systems, and its implications are already the subject of considerable debate (Wilsdon & de Rijcke, 2019).

Thus, CI is Third Wave scholarship which offers a more sophisticated approach that emphasises the interdependence and co-constitution of structure and agency. Actors make sense of their context through interpretive frameworks, which are themselves contextually and politically contingent. That is, actors' relative position within the governance regime

affords them more or less power to install one interpretation over another (Parsons, 2018). At the same time, certain contextual conditions give disproportionate weight to certain types of ideas or to certain actors as sources of ideas. Therefore, it is not enough to talk about the role of actors without specifying which actors and how they are positioned within the governance regime.

For example, in public research governance, new ideas are just as likely to be generated nationally as they are by transnational actors, such as the OECD, the EU, the World Economic Forum and large research-intensive countries (Braun, 2006a; Henriques & Larédo, 2013b; Mejlgaard, 2017; Musselin, 2011). External ideas are likely to be especially significant in small countries with less analytical capacity for science policy. National actors, for their part, may be from within the public research sector or from other public policy sectors that rely on the knowledge generated by the research sector (Musselin, 2011).[17]

Furthermore, actors may be from either policy-making or researcher communities, or they may be 'boundary actors' such as state agents drawn from within the academic sector such as Research Councils and other state sponsored funders (Wesselink & Hoppe, 2020). Each of these types of actor is a potential 'ideational broker' (Schrad, 2010). Their relative influence, however, will depend on their position within the policy landscape (Parsons, 2018), and the resonance of their ideas with national institutional settings and material realities (Campbell & Pedersen, 2015).

[17] Interdependencies between sectors is characteristic of public research, which may be co-funded from other sectors, and which will provide policy relevant knowledge to other policy sectors

Thus, CI acknowledges interacting (often interdependent) and multi-level factors involved in institutionalising the paradigm that underpins a governance regime within a sector (Blatter, 2017; Zittoun, 2015). This view has implications for how to analyse RSI regimes. It does not deny that policy action and governance arrangements may be path dependent, but nor does it presuppose that the path is materially or structurally inevitable. It is in how actors interpret the structuring conditions that paths are maintained, or new ones established. At the same time, the institutionalisation of one interpretation over others, is itself dependent on actors' relative influence and the institutional and material resources they can mobilise (Borrás et al., 2023; Borrás & Seabrooke, 2015).

Figure 1 posits a combination of HI and CI concepts and processes that, it is suggested here, underpin national research governance regimes. Inspired by both CI and HI literatures, this conceptual model assumes that the public research regime's component parts are mutually reinforcing over time, provided there is a stable shared interpretive framework which consolidates the regime. This model serves as the basic template on which can then be drawn the specific factors and processes that either institutionalise or destabilise the shared interpretive framework at the heart of a country's research policy regime.

This stylised governance regime is conceptualised independently of its multi-level context, however. Therefore, Figure 2 places it within a broader context of exogenous influences (Benner, 2018; Musselin, 2011). This positioning is intended to illustrate the well-described central tension in RSI: It is domestically funded and governed, but relies global interactions to fully legitimise its outputs (Wagner et al., 2015; Wagner & Fukuyama, 2008).

Material factors within these broader domestic and global contexts also play a role. For instance, national economic and natural resource interests can influence how the social purpose of research is interpreted and thus can structure policy priorities. At the global level, major transnational events and conditions (e.g., financial crisis, pandemic, terrorism, war) historically have had knock-on effects as the RSI sector responds to them domestically. The multiple pandemic-related collaborative research mechanisms that have emerged nationally and globally since March 2020 are a vivid illustration of this effect. More recently, the call to align national research systems to collective challenges is a new level of global influence. The interaction between domestic and global levels in this nested conceptual model is particularly important for small states which must leverage international connectedness due to limited resources.

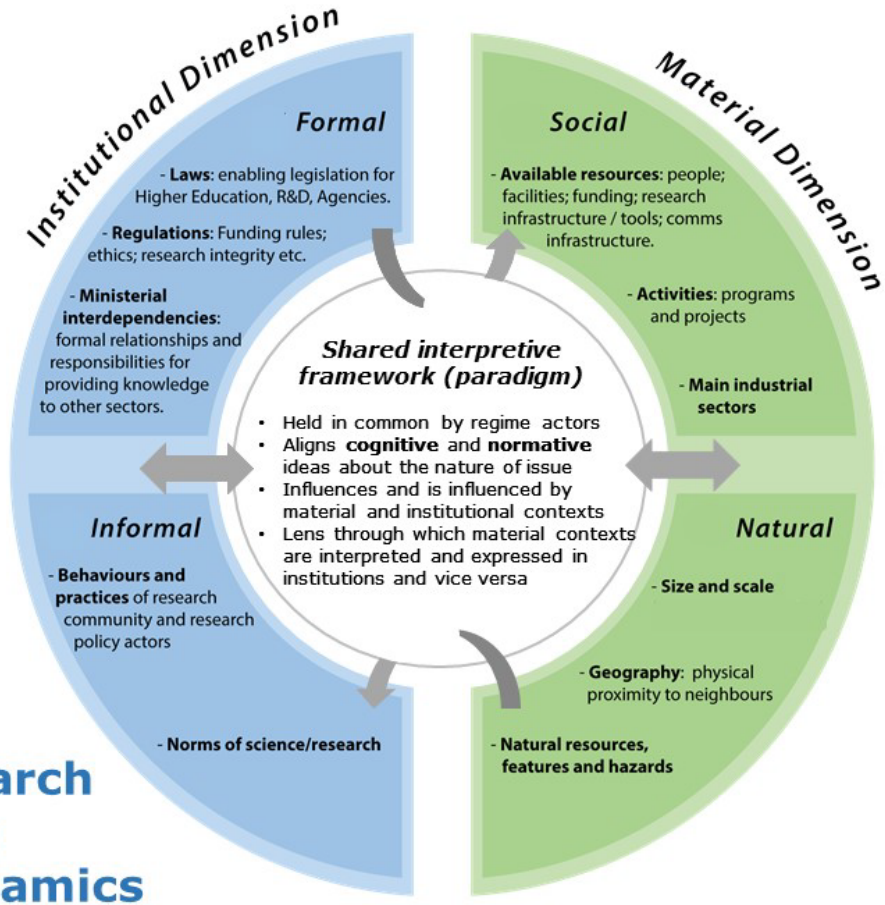
Interdependent Factors

Shared interpretive framework (paradigm) aligning ideas about: the nature of the problem; objectives, priorities; operational arrangements; role of actors (Daigneault)

Regime Actors have different levels of access and influence to shape the paradigm according to their interpretation (Parsons)

Institutional Context comprises both the formal and informal 'rules of the game' in RSI sector, and its sectoral interdependencies

Material Context comprises both the 'social facts' and 'natural facts' with material effetcts



Public Research Governance Regime Dynamics

Key Processes

Aligned and shared cognitive and normative ideas build and stabilise the governance paradigm and thus the regime built on it.

Mutual reinforcement of the structural conditions in which actors are embedded and the paradigm through which actors interpret those conditions. This creates institutional **path dependencies** over time

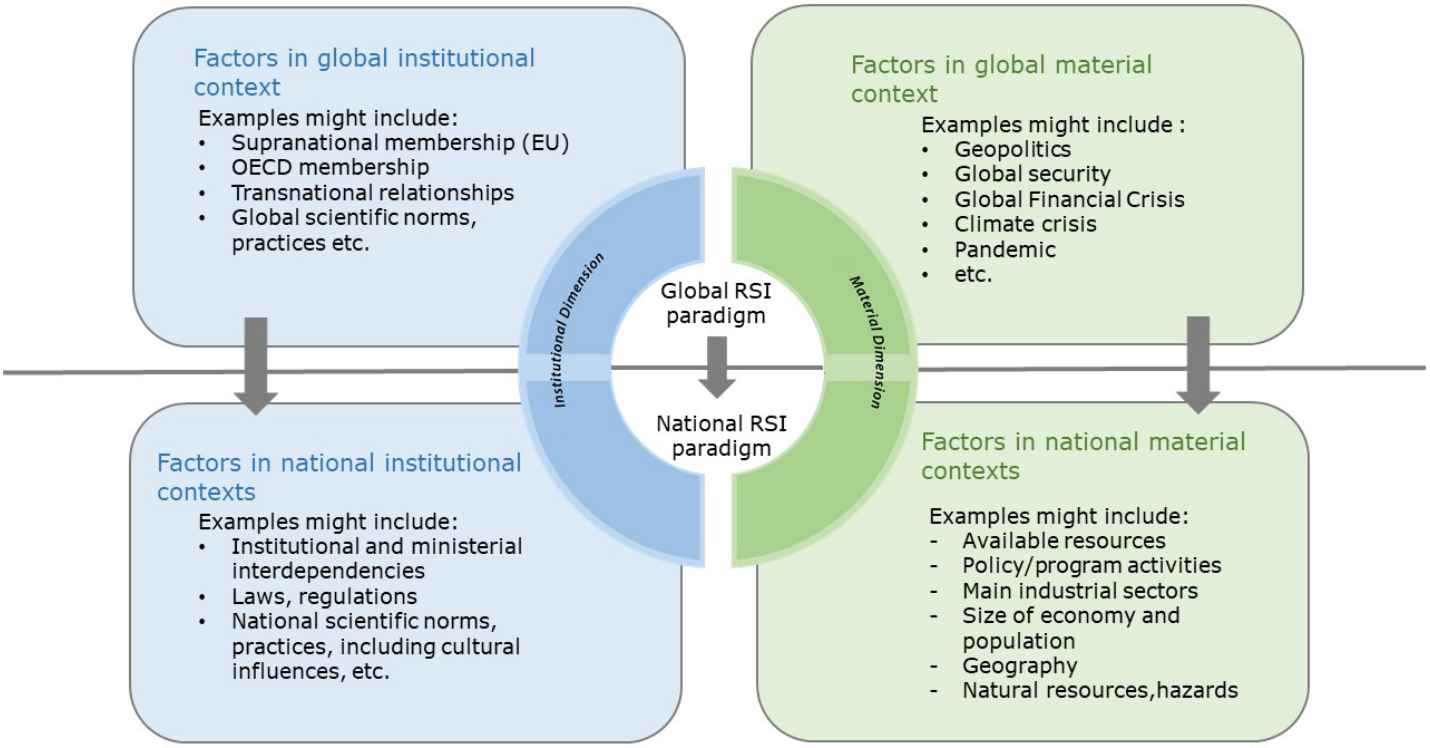
Regimes destabilise when new interpretations trigger internal dissonance in the paradigm or cause it to lose resonance with material and institutional context. Ideas lose legitimacy

Sources: This original model is inspired by several theoretical concepts in the literature:

- **Governance regime definition:** Skogsdad (2011): *"A set of shared ideas held by actors and the structural arrangements in which they are embedded,"*
- **Structural arrangements** as material & institutional (Daigneault 2014).
- **Material context** as both social & natural facts (Porter 2011)
- **Institutional context** as both formal & informal (Streek, Thelen date)
- **Actors'** relative positions give them different influence (Parsons 2011).

Figure 1: Public research governance regime dynamics

Figure 2: Public research governance regime in global and national contexts: material, institutional, ideational influences



Chapter 4 Study Design

To examine the dynamics of public research paradigm construction, stabilisation (and eventual destabilisation and replacement) in small countries, New Zealand and Denmark were chosen as primary study cases. For case comparisons, the underpinning constructivist theory locates more explanatory power in internal dynamics and relationships, than in strict unit by unit comparison across cases. Nonetheless, careful case selection is important to enable observations of interest, if not to clearly establish phenomena. Kimberly Morgan's cautionary note is relevant here:

> Once one takes seriously the non-independence of observations, complex interaction effects, equifinality, endogeneity and the power of path dependence to transform the subsequent operation of variables, which gave rise to a phenomenon, one can grow more sceptical about much comparative research, qualitative or quantitative. For instance, fundamental to comparative inquiry is the assumption of unit homogeneity – that variables operative in a uniform fashion in different contexts and time periods, but can this assumption be reliably sustained? Whether one is making comparisons over time or across space, ceteris paribus assumptions are often deeply unrealistic. (Morgan, 2016)

Morgan's observations emphasise the problematic assumptions that are found throughout much of the methodological cannon in the policy scholarship.[18] It is not the comparative method itself that she calls into question, but its underlying assumption of discrete, static and objective units to compare.

[18] Even the self-proclaimed positivist ideational scholar Peter Hall, having established the plausibility of ideas as a driver of policy, came to grapple with largely constructivist concerns in his later work. He asks: how does gradual institutional change condition critical junctures, and if institutions ultimately depend on social coalitions, how are those social coalitions themselves structured by institutions? (Hall, 2013)

Constructivist accounts, by contrast, make no a priori assumptions about the independence of explanatory factors or of direct cause-and-effect relationships. Instead, they focus on the interaction (and often, interdependence) of factors in contextualised relationships and processes (Chou, 2016; Hay, 2017). This approach to comparison therefore "adheres to configurational thinking, which means that the goal is not to reveal the causal strength of distinct factors of influence, but to shed light on how they join forces to produce the outcome of interest" (Blatter and Haverland 2016 p.19). Thus, to the extent that structural (i.e. material and institutional) factors are theorised to constrain agency, they are considered to be in a dynamic relationship of mutual influence with agents' own sense-making and relative position (Ylikoski, 2013).

It is important to ensure the ontological alignment between the theoretical and methodological choices made in this study (Morgan, 2016). This alignment is especially significant in a study that draws on conceptual insights from a variety of perspectives, not least a theory of material influences within constructivism (Cairney, 2019). The following sections thus lay out how the comparison of interconnected material, institutional and ideational factors is operationalised, guided by the conceptual model of the public research governance regime laid out in Figures 1 and 2.

4.1 Case Selection

Case selection for meaningful comparison has conventionally rested on assumptions about the comparability of discrete units across time or space. [19] However, as has been pointed out, such assumptions ignore complex and co-evolving interdependencies and instead seem to take for granted that static cases are compared at a single point in time (Morgan, 2016). For this reason, rather than comparing 'units' across cases, this study will compare identified processes of paradigm construction and how specific factors (material, institutional, ideational) clustered to produce these processes over time in New Zealand and Denmark.

Selection of these two cases follows a 'mostly similar' design using three criteria: small size, advanced industrialised economy, and democratic governance with regular multi-party elections that are recognised contests. These criteria were used to yield an initial suite of cases of public research systems that would be expected to face complex governance choices and ideational debates as actors sought to define the globally evolving purpose of public research for their own national contexts.

These criteria are justified in the following ways. First, small size not only allows a better view of full research systems, it also can be expected to lead to interesting contestation over limited budgets and prioritisation. Second, ruling out non-democracies (and highly managed democracies) is justified by a similar motivation to examine contestation and

[19] Classical case selection owed much to Mill's method whereby similar cases are chosen, which differ in the dependent variable (outcome). Comparing in this way aims at identifying the independent variables, which are thought to explain the presence or absence of the dependent variable of interest.

governance complexity. And third, advanced economic status is a prerequisite for small states having established public research systems at all. According to the International Monetary Fund, economic status is judged by the prosperity indicator of GDP per capita, the degree of industrialisation, and the Human Development Index. It is to be expected, then, that economically advanced states of at least 5 million people would have a well-educated population and a publicly supported research sector. Based on these criteria, analysis of small state research systems can be expected reveal insights that can be seen more easily than in larger systems.

Globally, seven jurisdictions meet the basic criteria for small economically advanced states with regular democratic elections of recognised contest. These are Denmark, Finland, Ireland, Israel, New Zealand, Norway, and Switzerland. In a larger, well-resourced project all seven case studies could be developed and compared. However, for the purposes of manageable comparison within the limitations of this thesis, these seven cases had to be narrowed to two.

In doing so, Switzerland was ruled out of the 'mostly similar' study design because it is slightly larger and because its federal systems make it an outlier. Cantonal funding of universities can be expected to alleviate some of the complex governance and prioritisation considerations that a unitary research system would be more likely to face. Israel was ruled out because of its larger size also, and the well-documented influence of defence science priorities that tend to unify the research governance regime dynamics. Finland was also ruled out because of the disproportionate influence of the multinational corporation Nokia that historically has exerted a unifying influence. The Norwegian system benefits disproportionately from the well-documented investment of state-owned enterprise

proceeds and was similarly ruled out. These influences would be expected to reduce the complexity and ideational contestation within the system, thereby attenuating regime dynamics and making them less visible for examination.

Only Denmark, Ireland and New Zealand meet the 'mostly similar' criteria while also showing likelihood of complex and contested research regime governance. Within this set of countries some distinctions are noted. For instance, New Zealand is the only eligible country outside of Europe. Ireland's past colonial relationship with Britain and its institutional and cultural similarities make it more similar to New Zealand than to fellow European country, Denmark. For these reasons, within the 'mostly similar' study design, it is the two most different countries that were selected to provide contrast within the category. For instance, the contrasts between New Zealand's largely liberal market economic model and Denmark's coordinated market model (Hall & Soskice, 2001) were expected to be of interest in research governance dynamics. This combination of case characteristics and novel analytical treatment reveals how institutional legacies (e.g., European Union membership, historic colonialism, varieties of capitalism) feature in the configuration of factors that shape governance paradigms and regimes.[20]

In selecting New Zealand and Denmark as the two study cases, a summary of the main science, technology and innovation indicators (as perceived and promulgated by the OECD)

[20] This case selection follows the advice of comparative politics pioneer Beryl Radin who urges analysts to consider similarities *and* differences between states because both are revealing. Radin suggests that close attention to inter-case differences can "complete a story" (Radin, 2019).

helps to situate the countries' RSI systems comparatively. Table 3 therefore summarises how the share of public financial expenditure[21] and effort within a country's public research system is balanced across by the three main classes of research performer: Higher Education, Government and Industry. Taken together, these indicators characterise the research intensity of each case country. Changes of the main research performing sector over time are also indicated (OECD, n.d.-a). For context, the table includes indicators for the OECD in aggregate.

Table 3: Overview of financing and performance of research in case countries. Statistical estimates from OECD Main S&T Indicators database, accessed May 2022. Showing the latest date for which there is data for both countries (2019) at the time of writing

		Industry Sector		**Government sector**		**Higher Education Sector**		
	GERD as %GDP (2019)	%GERD financed by indus. (2019)	%GERD performed by indus. (2019)	%GERD financed by Gov (2019)	%GERD performed by Gov (2019)	%GERD financed by HE (2019)	%GERD performed by HE (2019)	%GERD financed by foreign $ (2019)
NZ	1.41	49.95	59.55 42.7 (2008) 37.0 (2001) 21.7 (1981)	31.13	16.66 27.0 (2008) 32.2 (2001) 60.0 (1981)	9.85	23.79 30.2 (2008) 30.7 (2001) 15.8 (1981)	9.06
DK	2.89	59.25	62.10 69.9 (2008) 68.8 (2001) 49.7 (1981)	28.65	2.95 2.6 (2008) 11.8 (2001) 22.7 (1981)	6.46	34.54 27.2 (2008) 18.9 (2001) 26.7 (1981)	5.64
OECD	2.51	63.84	71.53	23.81	9.55	5.02	16.27	7.32

[21] The overall Government Expenditure on Research and Development (GERD), expressed as a percent of GDP, is the common indicator used by the OECD to compare research systems across member states, along with each state's relative allocation to specific research performing sectors: 'intramural' government researchers (Government Expenditure on Research and Development, or GOVERD); Universities and other degree granting public institutions (Higher Education Expenditure on R&D, or HERD); Industrial research (Business Expenditure on R&D, or BERD. In turn, these sectoral allocations are expressed a percent of GERD rather than GDP.

Denmark has long been among the most research-intensive countries (more so even than US, by per capita measures). However, its government sector has performed less of that research[22] compared with its industrial sector. As well, as will be discussed, Denmark significantly rebalanced its government and higher education research portfolios with major reforms in the early 2000s.

New Zealand is at the other end of the spectrum, with comparatively low research intensity. In contrast to Denmark, NZ has a uniquely large proportion of research financed and undertaken by government through a system of public research organisations (PROs), which are known in New Zealand as Crown Research Institutes (CRIs). These distinctions provide further contrast between these 'mostly similar' countries, thereby offering further opportunities to observe the roles and interactions of material, institutional and ideational factors in leading to the different shape that each system has taken. Moreover, the fact that New Zealand is (at the time of writing) contemplating the future of its PROs also offers the opportunity to explore how and why this latest governance tension came about. A more detailed description of these institutional and material contexts for each country is presented in Appendix 1 as a reference.

4.3 Case Design

As the forgoing discussion makes clear, the 'small states' criterion of this study yields a limited candidate pool, which necessitates a small-N design. In turn, small-N comparisons are best

[22] Not including the higher education sector, which is categorised separately according to the OECD

approached by prioritising within-case detail first (Beach, 2016, 2017). One way of generating such detail is through process tracing (Parsons, 2013).

Typically, process tracing follows the cause-and-effect path leading to a pre-identified policy outcome of interest (the independent variable). This method produces a contextualised and intensely detailed diachronic picture, revealing temporal inflection points and any patterns in the evolution of a phenomenon over time. When used comparatively, this technique is thought to help explain observed similarities or differences in influential factors across multiple cases (Collier et al., 2010).

In this thesis however, the constructivist approach suggests that it is the processes that reinforce or destabilise underpinning interpretive frameworks that are first identified and then traced, rather than processes leading to a particular policy outcome. Drawing on the literature (Hay, 2008, 2016a; Zittoun, 2015), table 4 therefore outlines how these processes can be broken down:

Table 4 : Processes of paradigm construction, institutionalisation and destabilisation

Identified Process	**Representations of the process**
Destabilisation of existing governance paradigm	Organisational arrangements, institutions, practices are under pressure to change.
Normalisation of new ideas	Actions that test, plant, circulate new ideas. This may happen simultaneously with destabilisation of the existing paradigm and in fact contributes to destabilisation
Institutional embedding of ideas	Actions that rank and codify ideas, establish routines, SOPs, institutional development or reorganisation
Routine application of "cognitive filters"	Coherence across governance activities, representations, institutions and practices that serve to assess new input.

While it may appear that the preceding list represents discrete and sequential stages, this is not always the case as there can be chronological overlap in these representations of a

process, especially as destabilisation starts to occur. Tracing these processes in each case study starts by identifying and chronologically plotting their representations and mapping how these cluster with factors in the wider material, institutional and ideational context.

Tracing processes of paradigm institutionalisation (and destabilisation) in this way, differs from the use of process tracing to establish independent causality for a dependent variable, which is also done through sequencing techniques (Collier, 2011). In addition to sequencing, this study also makes use of discourse analysis (Vromen, 2018), as both a technique and as general theory of politics within the constructivist perspective (Crespy, 2015)

As a technique, discourse analysis focuses on the use of communicative forms (e.g. verbal and written text, visual imagery and numerical representations, juxtapositions and framings) as an indication of broader social, political and cultural frameworks of understanding (Ezzy, 2002). This thesis uses discourse analysis in this way to identify evidence of a paradigm in the first instance. Based on the literature, a paradigm is represented discursively in data such as: statements about the rationale for public support to research; priorities the state sets for research funding; and the operational arrangements of the sector including the role of government and through which ministry(ies) it is played (Kern et al., 2015). Enduring coherence across these data over time reveals an established paradigm. Conversely, disconnects (internal or with surrounding context) such as statements of priorities that are not matched by commensurate operational arrangements indicate a fragile or destabilising paradigm, open to contestation and change.

Second, as a general theory of politics within constructivism, discourses are seen not only as *indications* of broader shared interpretations (paradigm), they also 'do work' in constructing them. In other words, it is discourses that reinforce or destabilise 'shared interpretations.' Discourse analysis must therefore consider not only the communicative act, but also the structural contexts, the power relationships of actors and the material conditions that both influence a paradigm and may be perpetuated by it (Crespy, 2015; Schmidt, 2011, 2017; Zittoun, 2009). One way to operationalise this approach is to trace the "development of policy statements through the places and moments in which they are made, through the actors who deploy them and try to stabilise against opposition" (Zittoun 2009, p.80). While Zittoun's suggestion is aimed at changes in specific policies rather than whole governance regimes, its intent can apply equally to the level of the governance regime (fig. 1). This is especially true for the RSI sector, where decisions about governing arrangements *are* the policy intervention (Aagaard, 2018).

For both case studies, an analytical grid (See appendix 3) is used to plot representations of paradigm construction/destabilisation processes within each paradigmatic period, and to relate these to relevant factors in the material and institutional context at both domestic and transnational levels. Dissecting the processes in this way can reveal the role and interplay of factors in shaping and then destabilising the governance paradigm. In turn, revealed patterns are compared across periods within cases, and between cases. Thick description also helps to disentangle the factors involved in the theorised processes over time.

Analytical procedure

Both case studies underwent a three-step empirical and interpretive analysis to develop within-case detail on how factors configure to drive the processes of institutionalisation or destabilisation of successive governance paradigms. These steps were then followed by cross-case comparison.

Step 1: Context and chronology

The first step was to establish a chronological picture of national contexts (generally and for RSI sector specifically) using both primary sources and secondary literature, supplemented with key informant interviews (see section 4.4). These data were used to generate timelines of the evolving institutional arrangements, material circumstances, and the actors, initially without any special regard for institutionalisation or destabilisation processes. Timelines covered 2010 to 2021 in detail, but best efforts were made to obtain more historical data to enable more comprehensive diachronic analysis.[23] When interviews and documentary data began to point to the same key events or discursive representation, it was deemed that saturation had been achieved, completing the historical and contextual picture.

Step 2: Identifying the dominant paradigm(s)

Timelines were then interrogated for discursive evidence of the dominant paradigm(s) by coding their content according to four identifying characteristics derived from the

[23] Data for the years spanning 2010-2021 was collected systematically for each country. However, many antecedent events or institutional precedents date from at least 2000 or decades before. Where these were mentioned by multiple interviewees, or where they were raised in the country-specific literature, they are included in the timeline. It was impractical to formally extend the time-period of data collection due to inconsistency of data

literature (Kern et al., 2015; Skogstad & Schmidt, 2011). Just as these characteristics were applied to identify and summarise changes within the global paradigmatic periods in chapter 2 (Table 2), so too are they applied to both case studies of New Zealand and Denmark that follow. As a reminder, these four identifying characteristics are summarised in Table 5.

Table 5: The identifying characteristics of a research governance paradigm. Adapted from Kern, Kzemko and Mitchell, and from Howlett (2015), and Skogsdad and Schmidt (2011)

Rationale	The 'Why' of public research, revealed in the claims that are made by dominant actors about the social value of public support to the research sector.
Policy objectives and thematic priorities	The 'What' of public research, paying particular attention to evidence of prioritisation and justification for prioritising, and to mentions of domestic and international considerations.
Operational arrangements	The 'How' of public research, paying particular attention to evidence of doing, organising, or governing research practices differently
Key actors and roles	The 'Who' of public research, paying particular attention to who speaks for public research and who makes decisions. Who are the pressure actors, including both domestic and international ones? How is government represented what role is government seen to play?

The sectoral paradigms within each case timeline could be seen in the patterns of coherence across these categories. Sustained patterns over multiple years were taken to be an indication of a dominant paradigm. At the same time, distinctive periods of policy change or emerging dissonance were noted within the broad paradigms (Benner's three governance "generations"). The paradigm characteristics were observed within each of these periods, to detect evidence of institutionalisation or destabilisation of the shared ideas holding them together.

Step 3: Interrogating timelines for evidence of institutionalisation/destabilisation processes

Once the basic timeline of research governance was established, and its distinctive periods were recorded, the chronology was interrogated a second time. This time, it was to

identify the sequences of activities, events and contextual factors associated with the processes of (1) destabilisation of the old paradigm (2) normalisation of new ideas, (3) institutional embedding and (4) routine application of paradigmatic practices (see table 4). Particularly attention was paid to time of transition between one distinctive period and other to assess whether the disruption might be a more fundamental shift in the underlying paradigm. For this exercise, the analytical template (See appendix 3) helped to show how events, contextual factors and sense-making by actors clustered in particular ways to construct or destabilise the underlying governing paradigm and shape the governance regime. Using the analytical grid allowed these case-specific configurations of factors to be compared with some consistency across cases.

Such comparison is not without challenges, however. As Colin Hay suggests:

> […] process tracers in political science and political economy might gain by reflecting on anthropologists' typical modesty when it comes to inferring the existence of social processes from the social practices they analyse. (Hay, 2016a)

Indeed, the linkage inferred between the theorised processes and the interplay of factors driving them can only ever be considered tentative. However, it is strengthened by the richness and diversity of empirical data connecting to a plausible narrative. This use of process tracing, Hay argues, is about empirically – if tentatively – identifying patterns and teasing out phenomena within a branch scholarship that is otherwise "uncomfortable with strictly Humean causation" (Hay 2016a p. 503).

4.4 Sources of Data

A variety of quantitative and qualitative data was collected at multiple levels to characterise the material and institutional conditions of each case over time. Discursive data were

collected to illustrate interpretations of the social value of public research systems and how such value was given effect. These data were supplemented with key informant interviews with policy actors (numbering at least one, but ideally three, from each of the actor categories that constitute the national research system: Policy-making; Funding; Research Performing). Key informant interviews of at least two uniquely knowledgeable academics in each country were also undertaken.

Empirical facts

Because this is a system-level comparative study, the research design necessarily trades off detail for breadth of scope (Radin, 2019). Thus, whereas much of the literature has focused on changes at the micro level (policy instruments)[24] as the main manifestations of the evolving social contract for public research (Chou, 2016; P. Maasen, 2014; S. Maasen & Dickel, 2019; Musselin, 2011), this thesis only considers policy instruments if they have had a significant effect on the overall governance of the system. For instance, if a research policy instrument has led to demonstrable re-organisation the sector's governing arrangement or key actors, it was included within the case's data set (e.g., the advent of interdisciplinary Centres of Excellence as a new way to organise research performers). By contrast a new funding application template or reporting instrument would not be included.

In addition, the main contextual data sources that characterise the governance regimes are the internationally standardised indicators, which are reported annually according to the OECD's Frascati Manual, to provide a snapshot of the organisational and

[24] Such as funding programs, eligibility criteria, performance indicators, and new forms of regulation

funding arrangements of national research systems. Data points such as financial resource levels and the infrastructure of the research environment are clear comparative indicators of the material conditions of each national public research systems and their institutional arrangements, both within a case over time and across cases.

Contextual data from outside of the public research sector also were collected because of the expected importance of broader material conditions and exogenous events. For instance, national elections and prevailing public policy priorities or controversies were recorded.[25]

Facts as discourse

In classifying each country's research system indicators according to material and institutional dimensions of the governance regime, it is understood that they are not simply structural givens but are also themselves the outcomes of previous decisions taken by policy actors, and thus illustrative of a particular interpretation of policy aims under a particular governance paradigm. As Kaare Aagaard points out:

> […] the level of material resources available and the criteria adopted for their allocation are closely linked to policy objectives, revealing in empirical terms the assumptions and ambitions that governments hold for higher education and research systems. (Aagaard and Schneider 2015 p.519)

Moreover, the indicators that national and supra-national policy actors choose to set for measuring performance of the public research system are themselves representations of

[25] Most of these data were collected before the Covid-19 pandemic, which would become the most significant exogenous factor to affect research public research systems since the Second World War.

processes of normalisation and institutionalisation of a particular paradigm. In this way, structural arrangements and quantitative indicators serve both as contextual data about material and institutional factors, as well as discursive data that reveal ideas held about the social value of public research at national and transnational levels.

For instance, budget allocation is internationally recognised as the most basic instrument of research governance and says something about available material resources. Expressed as a percent of GDP[26], the national RSI budget is the common indicator used by the OECD to compare research systems across member states, along with each state's relative allocation to specific research performing sectors (see table 3, p.75) The allocation format across these sectors is also tracked by the OECD, and conventionally expressed in a series of binary decisions[27]. While specific allocative instruments are too narrow in scope for this thesis, any change in the balance of the policy mix is nonetheless a data point of interest. It indicates, as Aagaard suggests, fundamental changes in the government's policy goals for public research, as an instrument of broader policy goals.

[26] The European Commission set a global benchmark for national public research funding when it declared, in 2003, the policy target for member states to allocated 3% of GDP for public research in an effort to encourage the development of knowledge-based economies (European Council, 2000). Since that time, the 3% target has become a de facto goal for most advanced economies including those outside of Europe.

[27] These binary policy choices include the relative allocation of resources to: researcher-directed vs government-directed studies; to public interest vs commercially appropriable research; to well-established and incremental areas vs investment in risky new frontiers; large scale programs vs smaller individual projects; and, at a more granular level, to STEM subjects vs Arts and Humanities. The binary decision model is so pervasive in research policy discourse that the OECD's database of country research policy profiles long used the visual metaphor of a toggle bar spanning the binary options to compare where countries stand on each.

Thus the 'social facts'[28] such as available budgets and resources within a governance regime, are part of the structuring material context on one hand, but also can be read interpretively as discursive representations of the governance paradigm, on the other hand. They emerge from, and serve to reinforce, a particular understanding of the values and aims of the public research endeavour. Alongside these 'social facts', the 'natural facts' related to material contexts such as geography and size are less malleable factors, but they are no less influential depending on how they are interpreted by actors. All mentions/occurrences in the data of such 'natural facts' of the material context (especially size) were noted.

In terms of the institutional context, data collected included the relevant legislation and the institutional arrangements of the research system (e.g., ministries, peak bodies, funding and oversight agencies and practices within the public research sector). These are structuring elements of the governance regime that can enable or constrain action. As the product of deliberate decisions, they too can be read discursively (Schmidt, 2017). In fact, to see them as either structural or discursive data would be to deny half of their causal capacity in shaping and consolidating the underpinning paradigm of the research governance regime. In addition, these institutional data are also important in establishing the key policy actors, their relative influence, and the interdependencies with other public policy sectors.[29]

[28] The conceptual model contrasts 'social facts' and 'natural facts' within the material context. While the latter is a structuring feature that is naturally occurring, the former would be considered a structuring feature in a classic economic sense only.

[29] In most economically advanced democratic states, policy actors include: Ministers of science, innovation and – often – business or enterprise and their officials; Ministers of Higher Education; University and Research Institute executives; Leaders of industry or representative bodies of the various industrial knowledge-based industrial sectors; Funding council executives (private philanthropic or public funders at arm's length from government); Directors and chairs of national and discipline-based academies; Organisations representing the scientific workforce. The policy role and relative influence of any of these actors can vary by jurisdiction and can fluctuate depending on economic and political context and historical precedent.

Discursive data: The interpretations and perceptions of purpose

Other discursive data were more easily identifiable. They clearly derived from interpretation and did not double as a part of the material context. These data were collected through internet searches of publicly available records, reaching from 2022 as far back as possible (generally a decade or more), as well as during site visits between 2015 and 2018. They included the following sources:[30]

Table 6: Sources of data to illustrate discursive context

Source of data	Type of data collected
Data originating at the national level	Issued by Head of government level: for instance, written statements or significant verbal or written mention of public research
	Issued by government from within public research policy sector: for instance, strategic plans national policy statements, or the consultative documents, reports or relevant studies undertaken by task forces, enquiries or committees on research policy, including their membership and Terms of Reference if available
	Issued by respected and influential thought leaders or representative bodies within the public research sector: for instance, responses to government policy statements; consultative or survey responses representing non-government sector stakeholders
Data originating at the transnational level for use by national actors	OECD country assessments of RSI sector, where available
	Biennial OECD country profiles based on results of member surveys
Data originating at the transnational level for generalised use	Guidance documents issued by the OECD's Science, Technology and Innovation Policy Directorate
	Guidance documents issued by the European Commission.
	General direction statements of three most recent European funding programs (Framework Program 7, Horizon 2020, and Horizon Europe

[30] During the research for this thesis, a new OECD database of public research and innovation policy documents became publicly available (https://stip.oecd.org/stip.html). This online tool archives data contributed through a biennial survey, and includes national policy statements, strategy documents and relevant study reports. Relevant document for available years were thus accessed through this database. However, data quality in the database is variable because contributions and survey participation is voluntary, and access is open. Some countries have a stronger commitment and a longer history of participation in the OECD surveys than others. Synthesis reports of the database material, prepared by OECD staff researchers were also accessed.

Key Informant Interview data

Publicly available data were supplemented by elite and key informant interviews, which were conducted between 2015 and 2019 in each country. The sampling strategy for these semi-structured interviews began by mapping and categorising national regime actors according to 'policy makers' 'funders' and 'research performers.' All peak organisations within each of these three categories were identified, along with their highest ranking official responsible for strategic policy. In the case of ministries, selected officials were non-political. Introductions were made through working-level staff, leading to invitations sent to officials through their secretariats. To further supplement the data, key informants with deep knowledge of the public research governance regime or a particular component of it were sought out for interview. See appendix 2 for a summary of the interviewees.

In semi-structured interviews, key informants were asked to recount a history of developments in research governance in their countries, and to identify and explain dominant debates and tensions in the governance regime. Follow-up probes were then enquired about key actors, contextual conditions and relationships surrounding decision points, the development of policy statements and other identified critical junctures in the chronology (whether introduced by informants or known from document analysis or secondary literature). Interviews were then transcribed and coded in the same way as documentary data.

Two rounds of thematic coding were undertaken. A first round sought to identify dominant paradigms by deductively coding the representations of discursive coherence across: the rationale for public funding of research; specific policy priorities; the operational

arrangements and juxtapositions; and key actors and their roles (both in contemporary and historical perspective). These data were tested against the chronology of governance changes and key events built up from other data sources so as to identify the paradigmatic consistency and distinctive periods of dissonance across the four features.

A second round of thematic coding focused on the processes of paradigmatic institutionalisation or destabilisation that could be detected within identified distinctive periods. This round concentrated on the points in the chronology where changes had occurred and then identified instances of tension or debate. From there, key informant's reasons given for tension were noted to develop themes using a combination of deductive and inductive coding. Deductively, each mention of the influence of institutional and material conditions, and of actors' (themselves or mentions of others') interpretation of debates or points of inflection were identified and generally categorised: origin, direction, perceived enabler/barrier. More specific themes were then developed inductively within respondent's explanations.

In addition, respondents' mentions of small size were specifically noted in their explanations to identify when it was mobilised and how it was it was perceived. This was done with a view to calibrating the exploratory use of small states as a study model. To this end, analysis remained attentive to any specificities of size that would need to be accounted for in the model, noting that these might nonetheless be interesting findings worth exploring further in subsequent research.

Using the methods just outlined, the two country case studies are presented in Part 2. Chapter 5 offers a contextual snapshot of current paradigms to orient readers to each case,

with supplementary material about each country's broader material and institutional contexts found in appendix 1. Chapters 6 and 7 then present the chronologies of paradigm construction in each country's public research system. These chronologies are punctuated with interpretive analysis of the interacting institutional, material and ideational factors that establish, reproduce or at times destabilise, the dominant paradigm. This analysis is further developed in chapter 8.

Part 3 then highlights the comparative themes across both cases and draws some tentative conclusions about what they might mean for the future of public research systems. It concludes with some thoughts on a research agenda that could build on the work of this thesis, both theoretically and methodologically.

PART 2 – CASE STUDIES

Chapter 5 Snapshots of Public Research Governance in New Zealand and Denmark

While some of the case study country context has been introduced already in section 4.1, with supplementary background on material and institutional contexts in appendix 1, this chapter now completes the picture by focusing on the ideational context, in other words the public research governance paradigm. Using the distinguishing features of a governance paradigm (see Table 5), the current paradigms underpinning New Zealand's and Denmark's public research systems are described. This chapter thus provides important background against which to understanding the processes of paradigm construction and destabilisation, which traced in the case chronologies that follow in chapters 6 and 7.

5.1 New Zealand

As a measure of its perceived significance, the overall expenditure on the research, science and innovation sector in New Zealand is relatively small by OECD standards. At 1.35% of GDP, general expenditure on research and development falls far short of the government's own target of 2% and the de facto global benchmark of 3%, set by the European Commission[31]. Despite producing abundant high-quality knowledge (nearly 16 publications per million dollars spent), New Zealand rates poorly in terms of promoting a knowledge-based economy that relies on industry investment and use of research. Business expenditure on research and

[31] Other counties cited by NZ's innovation agency (Callaghan Innovation) by comparison: Israel (4.25), Korea (4.23), Sweden (3.25), Switzerland (3.37), Japan (3.14), Austria (3.09), the United States (2.74), Norway and the Netherlands (2.03)." (Callaghan Innovation 2018)

development is just 0.64% GDP compared to the OECD average of 1.64% GDP (see table 3, section 4.1) However this had grown by 65% between 2010 and 2016 (MBIE, 2016, 2017).

In terms of operational arrangements, there are eight public research-performing universities, but more than 20% of the country's researchers are employed outside the university sector in one of nine state-owned Crown Research Institutes (CRIs). By comparison, only 3% of Danish researchers work in government research institutes and the OECD average is 10% (Borowiecki, 2018; OECD, n.d.-a). New Zealand's CRIs are established as crown companies and, according to New Zealand's former Chief Science Advisor, "excluding defence related activities, equivalent arrangements in many other countries, with some exceptions within Europe, are far more modest" (P. Gluckman, 2015).

As government-own companies, CRIs span the perennial areas of national policy interest in New Zealand[32]. Institutionally, they are required by the NZ Companies' Act (1993), their current enabling legislation, to undertake research "for the benefit of New Zealand" but in doing so, they must maintain their financial viability through commercially contracted research activity. In keeping with Neoliberal principles and related New Public Management practices instituted in the 1990's when the CRIs were created, each Institute's governing board is required to submit to the "shareholding minister" an annual statement of corporate intent which indicates, in addition to reports against performance indicators, an "estimate of

[32] The suite of CRIs is: AgResearch Ltd; The Institute of Environmental and Geological and Nuclear Sciences Ltd.; Landcare Research Ltd.; The National Institute of Water and Atmospheric Research Ltd; The NZ Institute for Plant and Food Research Ltd.; The NZ Forest Research Institute Ltd. There is no corresponding defence or health research institute. Significantly, the Covid-19 pandemic sparked renewed interest in establishing centralised public health surveillance, monitoring and research capacity, which by June 2021, was being discussed in the context of larger health system reforms.

the current commercial value of the Crown's investment." (Crown Research Institutes Act, 1992).

This operational structure of CRI's has been under critical scrutiny. First there was a government commission which recommended a significant institutional change to CRI's underpinning legislation. The review shone a light on the tension and potential negative consequences that regulation under the Companies Act can create for public interest research and regulatory science (MBIE, 2020). This review received little direct response from government during the pandemic, but in December 2021, a comprehensive Green Paper on the RSI system was launched for public review. It addressed in detail CRI's suite of thematic priorities and the tensions of its institutional settings (MBIE, 2021). However, as of March 2023, there has been no formal response to the consultation. The CRIs remain in a unique if tense position, which straddles the conventional pillars of regulatory science, knowledge generation and innovation.

Universities, for their part, come under distinct government ministry and funding envelopes within Treasury. The broadly scoped super-ministry of Business, Innovation and Employment (MBIE) oversees the functions of CRI scientists and the system of public contestable funding, which is accessed by both CRIs and Universities. Meanwhile the Ministry of Education oversees the Tertiary Education Commission (TEC), which in turn is responsible for funding and regulating the University sector through the allocation of performance-based bulk funds and some contestable research program funding. TEC is designed to keep university sector research funding at arm's length from government (MBIE, 2017). Though it is an intermediary agent of government, TEC's senior leadership comprises only government

officials, however its board of commissioners includes representatives of the university sector.[33]

There are also a small handful public-private research partnerships in the New Zealand research landscape, including one private (philanthropic) research institute of national significance. Otherwise, the University system accounts for the remainder of New Zealand's public researcher cadre, who operate under the terms of the Education Act (1989). This legislation sets out the governance structure and expectations of the research community within tertiary institutions. In contrast to the directionality of the CRI legislation, the Education Act not only protects academic freedom of researchers in their fundamental role as teachers and knowledge creators, but also bestows on them the role of "critic and conscience of society" (Education Act, 1989).

University researchers are also eligible for the same mission-led funding competitions to which CRIs can apply. As well there are two funding instruments which are exclusive to academics and designed to meet their need for intellectual freedom. These are the Marsden fund, which is a combination of individual project and program-based funding administered by the Royal Society of NZ, and large multi-year platform grants that support ten long-term Centres of Research Excellence (CoREs). Although the CoRE program is officially a funding instrument, the presence of ten centres as research platforms over a decade has had a profound impact on the small NZ system, creating recognised niches of academic expertise.

[33] It therefore differs from funding councils in other jurisdictions which employ academics in policy setting and funding of the University sector.

As scientist-led research platforms, the CoREs are a nod to the Scientific Freedom paradigm in a landscape that is otherwise dominated by contractual or specific mission-led research.

Indeed, the historic structural reforms that favoured neoliberal policies of managerial devolution, privatisation and competition gave rise to a model of commercial activity which has enabled universities, like CRIs, to also sell expertise on a contractual basis.[34] Essentially, university researchers may undertake contract research on university time and using university equipment and support. Fees are not paid directly to the researcher but kept in an account which they can access to conduct their own investigator-led research at their own discretion (Uniservices, n.d.).

Yet, the distinct mandates and aims of New Zealand CRI and university-based researchers mean they seldom overlap. To the contrary, in seeking some of the same contestable funding, the two research communities often end up competing with one another. However, The National Science Challenges (NSC), the most recently established class of long-term mission-led research platforms, are intended to integrate the two communities on areas of national priority, including human health, built and natural environments, agriculture and fisheries, natural hazards and materials science and engineering. The NSCs are funded and performance-managed by the Ministry of Business, Innovation and Employment, but administered by the research community acting as sub-funders.

[34] Globally, many universities invested during the early 21st Century on Technology Transfer Offices (TTO) in an effort to commercialise the fruits of public science through patents and 'spin-off' companies (OECD, 2003). By contrast, in NZ – beginning with the University of Auckland – commercialisation has focused on expertise and consultancy as much or more than technology patenting.

Internationally, long-term mission-led platforms such as these have been seen to produce sovereignty niches of expertise for which countries or regions can become internationally recognised (Glod et al., 2009). Depending on topic area, the long-term pay-off is not just the knowledge that is produced, but also a cadre of expertise that can attract further investment from innovative industry (Larrue, 2021). While the CoREs are long-term platforms led by TEC and university-based researchers and focused on education and fundamental science outcomes. The NSCs are designed to produce more immediate environmental, societal or economic impact and as such they are more government directed.

Apart from a health sector research funding council, which is governed slightly separately under the Ministry of Health (and which is not part of this case analysis), the final major component of the New Zealand public research sector is the collection of industry-facing programs that support innovation. In addition to tax-based programs to incentivise industrial research and innovation, direct funding and capacity building is delivered through a single business-facing Innovation Council (Callaghan Innovation). Operationally, the type of research and innovation eligible for government support through tax credits or start-up incubator programs varies widely. Although a policy goal is economic diversification through innovation, much public support to industry-led science has been in traditional areas of the primary sector such as farming and forestry, aiming at more sustainable and precision practices.

Overall, New Zealand's public research system has been characterised as highly directional and end-user focused. That is, it is tightly tied to the goals and priorities of government and industry, generating so-called close-to-market knowledge. Even university researchers, who are conventionally expected to push the boundaries of knowledge by

pursuing their own ideas, are incentivised and enabled to produce more applied work than discovery science, based on the terms of research funding available to them (MBIE, 2021; O'Connor & Harland, 2014).

Indeed, all forms of public research funding in New Zealand require applicants to articulate how their research will serve the "interests of New Zealand," though little explanation is given as to what this might mean.[35] Perhaps most revealing, is that even the two classes of undirected funding reserved for investigator-led research by academics require a demonstrable consideration of impact. For instance, in 2017 in response to Ministerial request, the Royal Society's Marsden program added the mission to "contribute in the long-term to economic, social, cultural, environmental, health or other impacts for New Zealand," explaining that "a key change [in its upcoming 'investment plan'] is to add impact as an explicit objective of the Marsden Fund and to clarify the Council's strategy for achieving this alongside other fund objectives" (Marsden Fund Council 2017 pp 3 and 18).

Using a policy lever such as investigator-led research funding to incentivise the production of knowledge with potentially significant impact for New Zealand (despite not specifying the kind of impact) is evidence of the government's interventionist approach to research governance. Similarly, TEC's performance-based research funding scheme (PBRF), an individual level assessment of researchers' outputs which is used to award bulk funding to universities, has required since 2013 that researchers reflect the scheme's "role in supporting

[35] It is left open to interpretation whether this means the 'national interest' or the 'public interest.' The former could include research aimed at anything from economic development opportunities to policy-relevant social and environmental priorities. The latter might also support government's priorities, but often involves critique and exposure of perceived flaws, which is indeed enshrined in the Education Act's 'critic and conscience of society'.

government's wider priorities in science, research innovation" (Ministry of Education 2019 p. 2). Additionally, PBRF now has the explicit aim to "support research activities that provide economic, social, cultural and environmental benefit to New Zealand, including the advancement of Mātauranga Māori", and to "support technology and knowledge transfer to New Zealand businesses, Iwi and communities" (TEC, n.d.). These aims are applied across all academic portfolios, from Engineering to Antiquities.

Since 2005, a growing policy imperative has been Vision Mātauranga, which is understood as both enabling Māori-focused and Māori-led research, as well as providing a lens through which to assess implications and amplify any benefits for Māori in all public research endeavours (MoRST, 2007). This policy has led to new ways of conducting research through the principles of community engagement and co-design, which echoes similar trends in Open Science internationally. However other international hallmarks of the Open Science movement, such as governments' requirements to make accessible data and results stemming from publicly-funded research, have gained less traction in New Zealand[36]. One reason for this may be the large proportion of public research that is industry-led or having and innovation aim, and thus potentially commercially sensitive.

Thus, if the way that public research is organised and funded is indicative of the way its aims and purpose are interpreted by policy makers, then New Zealand's regime has long

[36] Unlike jurisdictions such as Europe or Canada, there is no general requirement by New Zealand government funders to make publicly funded research freely accessible. However, since 2013, 5 of NZ's 8 universities have chosen to promote and enable the practice among their staff by creating university depositories for publications and data. CRIs do not normally make research accessible unless directed to do so by a commissioning minister (https://www.universitiesnz.ac.nz/sites/default/files/uni-nz/OA%20CONZUL%20Environmental%20Scan%20version%201.02.pdf)

reflected a belief that publicly funded research is a transactional business that serves clients by delivering knowledge products. For New Zealand, the social contract for research is not so much a metaphor for scientific freedom to pursue uncertain ideas, as it is a codified and documented set of performance-based assessments, reports to shareholding ministries, annual ministerial investment plans, and the commercial activities of both CRIs and University-based researchers for which they must be readily accountable.

Small size, limited resources and the growing recognition of obligations to Māori and with Māori scholars, has often been cited as the reason for which the underlying research governance paradigm has prioritised the explicit instrumentality of research (Boven, 2009; MoRST, 2010; National Science Panel, 2008). However, there has been less agreement on any particular policy priorities beyond the expression of Mātauranga Māori. For instance, the appropriate balance between public-interest and industry-driven research is a source of constant tension, made more difficult by the institutional and operational arrangements of CRIs.

Before casting the analytical gaze backwards to understand the historical processes of paradigm construction in both case countries, the next section now turns to look at Denmark's contemporary paradigmatic context.

5.2 Denmark

We believe that one of the primary goals for Danish research and innovation is to contribute to the green transition. Research and innovation are absolutely crucial for us to find solutions to the challenges facing our society. The entire parliament has recently agreed to earmark DKK 1.5 billion next year to green research and development. This is the first, important step. I am now heading the further work to see how the research and innovation system can be arranged to best support the green transition.

Minister for Higher Education and Science Ane Halsboe-Jørgensen, on the release of EU Expert peer review of the Danish national Research and Innovation system

(MHES, 2019).

Just as in the New Zealand case study, this section lays out the current paradigm underpinning the research governance regime in Denmark.[37] Comprising overarching policy rationale and objectives, operational arrangements and key roles, the governance paradigm reveals how the perceived purpose of public research is interpreted and enacted in Denmark. In contrast to New Zealand, Denmark's governance paradigm is intimately linked to the supra-national currents of European governance, with less explicit public dialogue and debate on at the science/society interface than has been seen in New Zealand.

Some of the lack of debate may be attributable to the fact that Denmark's research governance and funding regime had been largely stable and with relatively low public profile

[37] It should be noted that, at the time of writing (late 2022), the last available policy statements of substance regarding the direction of Danish research pre-date the Covid-19 pandemic. In fact, Denmark requested and received a full review of its system by the European Commission in the latter months of 2019. Like most countries, Denmark mounted an RSI system response during the pandemic, but any major and enduring policy shift resulting from the 2019 review remains to be seen.

for decades. Indeed, key informant interview responses consistently emphasised that decisions on its governance were largely bi-partisan and consensus based, in keeping with Denmark's governing tradition.

A key pillar of that stability, Danish government expenditure on research, science and innovation is among the highest OECD, expressed as a percent of GDP. Denmark leads Europe in exceeding the European Union investment goals for the sector, which Denmark itself was instrumental in helping to set. Although investing nearly double that of New Zealand as a percentage of GDP, Denmark's overall expenditure on public research and innovation has diminished slightly in recent years, from an all-time high of 3.09% in 2016. The incremental decrease surprised many in the Danish academic community who had long been accustomed to a stable budget that kept up with inflation.[38]

In terms of operational arrangements of the public RSI sector, there are currently eight research-intensive public universities in Denmark. All but two of Denmark's original public research institutes (PROs) were merged within these Universities during major sectoral reforms between 2004 and 2007 (Pedersen & Hvidtfeldt, 2021)[39]. Consequently, only 3% of Danish researchers work in two remaining government research organisations, which include a research institute on labour and workplace, and the national institute for infectious

[38] The incremental decreases were 3.03% in 2017; 3.02% in 2018 and 2.96% in 2019.

[39] The Technical University of Denmark hosts national research centres for sustainable energy, food, fisheries, space and transportation research; The University of Copenhagen hosts national research centres for veterinary and agricultural science as well as pharmacy; Aarhus university hosts national research centres for environmental research and educational research; Aalborg University hosts the research centre for planning and built environments; and the University of Southern Denmark hosts the national institutional of public health research.

diseases. By contrast, in New Zealand, close to 20% of the national science and research workforce is hosted in PROs, which is among the highest in the OECD (OECD, n.d.-a).

Universities are defined by Danish Law as "government funded independent institutions within the public administration" (The Danish Consolidation Act on Universities (The Universities Act), 2011). They are state-funded autonomous institutions, and admissions are supply managed according to labour market needs through a framework launched in 2014. Qualifications are certified in accordance with the Bologna Framework, thereby harmonising them across Europe through principles adopted by the European Ministers of Higher Education. While protecting scientific freedom, the Universities Act also enables the Minister to order a university to undertake certain tasks as deemed necessary by government, in negotiation with the University. This provision has underpinned and enabled the amalgamation of PROs into the university sector.

Universities (and all tertiary training) and the PROs within them, are governed by the Ministry of Higher Education and Science. The ministry's mandate combines the policy and funding to supply-manage post-secondary training and to oversee, steer and fund research. The ministry's stated vision – "Strong growth and new insight through excellent education and research" – signals in equal measure the significance it attributes to economic development (growth), public service (insight) and the autonomy of the research community to teach and create knowledge (excellence). It is also significant that these functions are combined within a single ministry, presumably to enable interlinkages and complementarity.

For instance, much of the Ministry's work is to develop and oversee multi-year Framework Agreements (contracts) between universities and government. These agreements

spell out how Universities will undertake some dedicated research and science-based activities to serve the public interest, effectively absorbing the role of stand-alone PROs in this regard. Universities are invited to bid on these multi-year contracts, which in turn provide for infrastructure maintenance, capacity building, and competency development opportunities within universities.

Integrating between universities and industry is Denmark's ground-breaking Industrial-PhD program, which was launched in 1970 to offer 3-year bursaries for students to gain experience in industry while contributing new knowledge for innovation. The three themes of the 2022 industrial PhD funding scheme reflect the intent of the Danish research system to address key societal challenges, in this case through innovation : 1) "Green research, technology development and innovation; 2) Life science, health and welfare technology; 3) Strategic and challenge-driven research and innovation in new technologies." (Innovation Fund Denmark, 2023)

While the Ministry oversees granting councils to coordinate its institutional, educational and investigator-led research funding programs (bodies for which have been streamlined into the Ministry in October 2020), it receives independent expert policy advice from the Danish Council for Research and Innovation Policy (DFiR). This advisory body was established in April 2014 when it amalgamated and appropriated the tasks of two predecessors – one focused on research policy the other on innovation policy. Their combination is another signal of Denmark's highly integrated perspective on public research. Furthermore, since 2019, the secretariate for this advisory function has been housed directly within the Ministry rather than as a separate (arm's length) entity, further signalling government's intensified interest. in the sector.

Where government has been less engaged, however, has been in Denmark's considerable private philanthropic sector. Despite there being around 1300 private foundations funding research in Denmark (the largest being Carlsberg, Maersk and Novo Nordisk) which account for the majority of scientific research funding, there has been surprisingly little joint discussion linking public and private policy agendas within the overall research ecosystem. Private foundations exist thanks to a quirk of Denmark's wealth tax which makes it fiscally advantageous for companies to be owned by charitable foundations (Thomsen, 2017). Yet, despite the proliferation of industrial players taking advantage of this law over the years, it was only in the 2019 review of the research ecosystem by the European Commission that the lack of systemic cohesion between types of funders was addressed (European Commission, 2020a). Foundations were out of government's policy reach, and it took a supra-national government actor to point out the missed opportunity to maximise each other's impact. The Review seemed to have broken an unspoken impasse between ecosystem actors because shortly after its publication, the government launched its first public-private funders' forum leading to jointly funded strategic research centres.

That the European Commission review should have had such an impact is not surprising given the history of institutional entanglement between the national and supra-national levels in research policy and governance. To understand the governance paradigm requires an understanding of Denmark's internationalist ambitions, its exceptional industrial sector and its position within European research policy discourse. For Denmark, the social contract for research is based on the tacit assumption that the public research system in a small, European country should deliver a *balance* of economic growth through innovation, and a knowledgeable population. Its innovation goals do not seem to sit in direct opposition

to its public interest goals, perhaps because knowledge-based industries are well established in Denmark, including with an embedded system of philanthropic funding and a history of predictable funding to universities. Any contest of ideas in this system seems to be more to do with getting the balance just right, with a mix of innovation, public-interest, domestic and European priorities.

The following two chapters now take a close look at the evolution of the public research governance regimes in New Zealand and Denmark. From the earliest recognisable RSI systems to the current models just described, these chapters examine the processes by which evolving ideas about the purpose and value of public research have shaped the successive paradigms underpinning each country's governance regime. As the two substantive empirical chapters in this thesis, they are expressly detailed to enable careful consideration of the interaction of ideas with material and institutional factors over time. These chronologies show how some ideas are institutionalised into regime-shaping paradigms, while destabilising others.

Chapter 6 Chronology of Paradigm Construction in New Zealand: The Price of Competition

In developing the New Zealand case chronology, it was apparent from literature and interviews that, to understand the contemporary organising paradigm of the public research system, its instability and what is emerging, it is necessary to go back to the structural reforms of the public sector in the last decades of the 20th century. However, these reforms alone do not tell the whole story. Their significance is in their interaction with the research system of the time, which itself is deeply linked to transnational issues in the development of NZ's Dominion status from the British Crown and subsequently its recognition of Māori rights and emergence as a Pacific nation. Thus, as most interview participants insisted, it is clear that today's public research regime is not a recent story. Table 7 previews each distinctive period of change that is detailed in the analysis that follows.

Table 7: Distinctive periods in research governance paradigms in New Zealand, discerned by paradigmatic features

RSI Paradigm (theorised in Lit)	Distinctive period	Rationale (Perceived social value of public investment in research sector)	Policy objectives and thematic priorities	Operational arrangements	Actors / roles
1st Generation governance paradigm (Scientific Freedom	**1923-1989** *Settler Science*	Knowledge provisioning - economic development - nationalised industry	- Primary sector development - human health	- Intramural researchers in government (DSIR) - Unis are not research intensive	- Department of Scientific and Industrial Research (DSIR) acts as both provider and purchaser
	1990-2001 *Competition focus*	Knowledge provisioning - regulatory needs - commercial contracts	Main focus is on reforming institutional structures	- Extramural (CRIs) - Competitive by design - Transactional research for private sector	- Setting institutional and policy conditions: MoRST - Funding research (termed "purchaser" of knowledge) under the neoliberal regime: FoRST; - Performing research: CRIs; Universities, CoREs) - Advocacy: NZAS; RSNZ
2nd Generation Governance paradigm (government -led, competitiveness-focused)	**2002-2008** *Competition +Accountability Focus*	Knowledge creation - Research-informed training in Unis - Economic diversification	- ICT - Biotech (genetic modification Royal Commission) - Creative industries	- Extramural (CRIs) - Competitive by design - Transactional research for private sector - Performance-Based funding (academic) - Collab. platforms for academic research - Longer-term programs	- Setting institutional and policy conditions: MoRST - Funding research (termed "purchaser" of knowledge) under the neoliberal regime: FoRST; TEC (CoREs, PBRF); RSNZ - Performing research: CRIs; Universities, CoREs) - Advocacy: NZAS - Advice: RSNZ; OECD
	2009-2014 First National Strategy - *Competitiveness and Prosperity*	- Supporting business - Better public service - Globally competitive	- High value manufact. - Biological industries - Energy and mineral - Hazards and infrastructure - Environment - Health and society	- Collaborative platforms for societal challenges - Innovation - End-user (industry) focused	- Setting institutional and policy conditions and funding: MSI (2011-'13) / MBIE (2013-present) - Performing research: CRIs; Universities, CoREs, NSCs) - Advice: SAEI; CSA; DSA; RSNZ; OECD and EU (via individuals) - Advocacy: NZAS
Emerging 3rd Generation governance paradigm (co-design, collective challenges, global perspective)	**2015-2019** Second National Strategy - *Competitiveness and Prosperity + Science in society*	- Prosperity - International competitiveness - Societal challenges - Regional economic development	- High value manufact. - ICT - Health soc. service - High val. primary pro. - Sustainable production and biodiversity protection	- Collaborative platforms for societal challenges - Public engagement - End-user focused	- Setting institutional and policy conditions: MBIE - Funding: MBIE 'Science Board' - Performing research: CRIs; Universities; CoREs, NSCs IROs - Advice: SAEI; CSA; DSA; RSNZ. - Advocacy: NZAS
	2020- Third National Strategy (draft) *Covid-19 recovery, defragmentation + decolonisation*	- Inclusive Knowledge society - Supporting government public policy priorities	- Mātauranga Māori - Transition to zero-carbon economy. - Regional dev. - Protecting the environment - Creating fulfilling and high-value jobs - Increasing wellbeing	Still to be determined Mentions: - Collaboration - Diversity and inclusion - Scale up winners - Mātauranga-informed	- Setting institutional and policy conditions: MBIE - Funding: MBIE 'Science Board' - Performing research: CRIs; Universities; CoREs, NSCs IROs - Advice: CSA; DSA; RSNZ; (unclear if there is a source on transnational advice) - Advocacy: NZAS

6.1 (1923 – 1989) Settler Science

Establishing new institutions according to material needs and resources

At the 1923 British colonial economic conference in London, Sir Ernest Rutherford advocated on behalf of his native New Zealand to establish a research base to underpin economic development. Two years later, the Department of Scientific and Industrial Research (DSIR) was born, enduring until the advent of the CRIs in 1992. DSIR was part of a typically colonial origin story for public research, which differs markedly from Old World systems that grew out of the university sector. As with Canada and Australia, public research in New Zealand was organised and funded by government for the express purposes of maximising material resources in agriculture and the natural environment for economic development. New Zealand universities were not yet research-intensive. Instead, the institutional context for research naturally articulated around the economic imperative of supplying the British Common Market and developing natural resources of the young nation (Galbreath, 2017; Gregory, 2017; Lewis, 2015).

As the British market turned increasingly towards Europe, the potential for growth in New Zealand diminished. By the early 1970s, the special economic relationship had faded, but trading ties with Australia grew. At the same time, the global energy crisis and rising inflation caused the conservative government to institute strong centralised measures to stabilise the economy (Singleton & Robertson, 2002). These had the opposite effect, and the government was thrown out in 1984, ushering in the famously neoliberal reforms of Labour Prime Minister David Lange. With structural changes between 1984 and 1993, “New Zealand

underwent radical economic reform, moving from what had probably been the most protected, regulated and state dominated system of any capitalist democracy to an extreme position at the open, competitive, free-market end of the spectrum" (Nagel, 1998). As one senior academic and subsequent government advisor remembered the time:

> We went through the same wild privatisation chaos that you saw with the Soviet Union breaking up. Some became very influential with Treasury. Central agencies, particularly Treasury, were strong as the government had seen the benefits of the move to free market so the government was enthralled with Treasury. We had young relatively doctrinaire people driving it. (Key informant interview, New Zealand science policy expert)

Normalising market-based ideas

For the research governance regime, these changes were exemplified in the market-based ideas that were introduced to this previously protected and exclusively funded sector. To incite competition, a system of contestable funding was introduced. Whereas DSIR had been a one-stop-shop for the policy, funding and performance of research, these functions were unbundled in 1989. While DSIR remained the main PRO research performer, the growing perception of the importance of managing the RSI system was signalled with the government's establishment of the Ministry of Research Science and Technology (MoRST) and its arm's length funding operation, the Foundation for Research Science and Technology (FoRST). From that point, government's role came to be seen as a purchaser of knowledge from its own intramural researchers – a label that reflects the market-based model that came to dominate policy making in New Zealand in the 1990s (Lewis, 2015).

> This is key, from there on the idea was that ministries in the 1990s *purchased* all their research requirements from the FoRST through a competitive bidding process. The policy direction was set by MoRST [the type of research needed] and the management of bids was done by FoRST. We [government researchers] had to bid into various output classes… The bids were quite granular because the Ministry and Foundation

were expected to know everything about the needs for science in this country. (Key informant interview, New Zealand emeritus PRO scientist)

This background of structural reform has had a long legacy. It institutionalised a competitiveness and accountability framing in a sector that had previously been well-supported, sheltered and exclusive to DSIR (Key informant interview, New Zealand). The creation of MoRST and FoRST also institutionalised the idea of transactionalism as an organising principle for the research system. Treasury's perception was that a Minister would purchase knowledge by issuing contracts following a competitive bidding process by the same DSIR researchers who previously had been directly funded. The perception that research outcomes were predictable products to be purchased became entrenched among policy makers, and indeed, self-fulfilling in the absence of long-term funding aimed at discovery and innovation. Though Labour lost the 1990 election, the changes made to research governance under Labour's reforms had set a trajectory that continued apace.

6.2 (1990 – 2001) Competition Focus

Institutional embedding: creating new organisational structures and markets

The new right-leaning National government did not in fact differ much from its Labour predecessor, and the new and activist Minister of Science (a former Rhodes Scholar) made more institutional changes in the early 1990s that formed the institutional foundation for today's governance regime.

As the minister for the dual portfolio of Environment and RSI (or Research, Science and Technology, as it was then), Simon Upton brought in New Zealand's Resource Management Act (RMA) in 1991. Two years later, he oversaw the disbanding of DSIR to create

the Crown Research Institutes, thereby promoting scientific specificity but also inciting further competition in the sector. The RMA required (and still does) that development and resource extraction proponents submit extensive evidence of impact and mitigation plans before a project is approved. Conveniently, the CRIs were enabled by Upton's legislation to undertake private sector contracts, a service that their predecessor DSIR was not set up to provide. They therefore provided a ready consulting service that could help developers fulfil the requirements of the RMA.

Thus, within the space three years, government had created a market demand for the type of research that few others beyond government scientists were materially equipped to provide. Government also ensured the institutional means to meet that demand by legislating CRIs to take private sector contracts. At the same time, CRIs continued to serve the regulatory knowledge needs of the state but did so also through a competitive bidding and contracting process. Minister Upton's interpretation of the role and value of public research was to provide a fee-based public service that also could be contracted by the private sector. The role of government had been to create the market for knowledge, which fit the overarching market-oriented policy-making paradigm of the time. It was also tailored to the perceived knowledge needs of New Zealand around primary sector industries and management of natural resources in the face of land use and development.

Any risk of conflict of interest in a CRI potentially serving both the regulator and the land developer was either overlooked, ignored, or entrusted to the integrity of the science. It appears never to have been called into question by officials until the inaugural Chief Science Advisor to the Prime Minister commented in a 2015 blog post that CRIs' "range of roles can create ongoing tensions and angst" (P. Gluckman, 2015). By that time, climate change and the

impact of industry (particularly primary industry) on New Zealand's environment were more present in the public consciousness, raising the issue of whether CRIs could remain impartial (Griffin, 2014). Thus, the changing context of the natural environment had begun to change the conditions of legitimacy for the CRI model.

However, any explicit notion that the public research system should rebalance its public and private mandates and activities seemed a long way off in the early 1990s. For one thing, as discussed in Chapter 2, this period was dominated globally by a rush toward industrial globalisation and national economic competitiveness, concepts that were already established in New Zealand's public research governance paradigm. Secondly, climate change and the impacts of intensive industry had yet to become mainstream policy problems, nor indeed were they material problems at that point.

In the higher education sector, institutional reforms by the incoming National government both reflected and further embedded the underlying market-oriented paradigm by moving towards a more competitive model of provisioning skills and knowledge as commodities to be purchased (Key Informant Interview, New Zealand) University research funding was allocated to disciplines based on student numbers. These reforms were controversial because they rewarded disciplines that were easier to teach with higher student numbers, which did little to promote research-intensity within the STEM subjects[40]. The Marsden Fund was launched in 1994, in part to address these criticisms. It has been characterised as a political safety valve at a time when the government and especially the

[40] STEM is an acronym of science, technology, engineering, and mathematics.

Minister's penchant for market-oriented approaches and managerialism was very unpopular with the academic community:

> Marsden was seen as the politicians' safety valve. It took the heat off the politicians so they could say 'we are doing really high-level, high-flying science too. CRIs couldn't get near the Marsden fund. (Key informant interview, New Zealand emeritus PRO scientist)

By the end of the decade, a review of the entire higher education system revealed the apparent limitations of the funding allocation model on research performance. The review pointed out the Marsden fund was not a systemic solution that alone could drive discovery and innovation, when the overall system was otherwise built on the piecemeal competitive contracts based on quickly aging policy ideas. The review recommended that $20M (approximately 20%) of universities' student-based bulk funding allocation should be reserved for undirected research activity. Eventually, the ratio was to shift over time such that 80% would go toward research while privately-paid tuition fees would rise progressively to make up the rest of universities' costs (MoE, 1998)

This research portion of funding was not without strings attached, however. The Minister of Science (Upton) essentially applied the $20M as universities' entry fee to the contestable pot that CRIs already accessed by bid, in order to perform research needed by the Crown. In bringing CRIs closer to universities in this way, Minister Upton sought to rationalise and align the small public research sector while inciting further competition, which was consistent with the government's market-based interpretation of the public purpose and function of research. However, the move disrupted any equilibrium the RSI system may have had. One emeritus scientist remembers the change:

> Universities' entry wreaked havoc, and it was all ideologically driven. They [government] thought that white-hot competition must lead to better science. The competition between the CRIs and with universities by then was vicious. Poor old CRIs had to compete with universities, who were not costing overheads into their bids at the time… (Key informant interview, New Zealand emeritus scientist)

These changes created conditions of instability that would endure. Indeed, the short-term, competitive and transactional interpretation of public research, which suited government, was incompatible with fundamental research and academic norms and conventions that required well-structured, iterative and cumulative processes for knowledge creation and development.

Incentivising universities and CRIs to compete with one another not only exacerbated the scarcity of resources, but it also introduced the potential for conflict of mandates. Universities had a legal responsibility to 'speak truth to power' while CRIs served power (and industry). Tensions and ideational contestation regarding these roles would arise in the two decades to follow as they would come into closer confrontation with the material impacts of growth and intensification of primary sector industries especially (Ashby, 2015; Ashby et al., 2019; Joy, 2021; Leitch et al., 2014).

6.3 (2002 – 2008) Accountability Focus

Destabilisation: competing perceptions of purpose

After a somewhat rocky start to coalition politics under the new proportional representation electoral system in 1996, New Zealand moved to a more institutionally stable government under Helen Clark's Labour party from 1999 to 2008. But this did not mean that the governance regime for public research was equally stable. Rather, perspectives on its

central purpose remained contested. As the Royal Society of New Zealand (RSNZ) characterised the situation at the beginning of the new millennium:

> New Zealand science has shifted from a period of no apparent change for decades to one of continual change as a new funding and provider structure attempts to meet conflicting requirements. (RSNZ, 2000)

Under Labour's new Minister for Higher Education (as distinct from the Science Ministry), who was himself an academic, research policy for tertiary education would move from a laissez-faire competition-based model to one that would be much more centrally steered specifically to meet national objectives. The newly elected Labour Alliance government wasted little time in appointing a Tertiary Education Advisory Commission (TEAC) which included academics with expertise in research policy. They were to review international university research models and make recommendations for one to suit the New Zealand context. Whereas the previous government's economics-driven form of policy making had allocated research funding based simply on student numbers, the TEAC offered a more sophisticated calculous albeit still according to an overarching market-oriented model (P. Roberts, 2007). In a series of papers issued between 2000 and 2001, the TEAC laid out the vision for the Performance Based Research Fund (PBRF) scheme, which would award funding to universities based on individual publication metrics, graduate completions and the amount of external funding received (MoE, n.d.).

In the midst of the TEAC's research and deliberations, however, the Royal Society (RSNZ) was issuing its own unsolicited advice, causing further destabilisation. This advice sounded the alarm on the competitive and transactional nature of both the CRI and higher

education, which would not achieve the transformative change that, it argued, New Zealand needed to become a "knowledge-led society" (RSNZ, 2000).

In its *Manifesto for Change in Science Technology and Innovation*,[41] the RSNZ put forward far reach reform ideas. Remarkably perhaps, for a manifesto coming from the National *Academy*, it focused almost exclusively on addressing the factors that were preventing industry from exploiting knowledge gains and those preventing universities from engaging in knowledge transfer to industry. This distinctive view of the social value of public research held private sector innovation and technology development as the "key to wealth" and recommended that NZ "identify and target winning areas of innovation." (RSNZ, 2000)[42]

The RSNZ cited New Zealand's limited size as a reason to prioritise commercially appropriable research. But structural and personal factors might also have helped shape this perspective. Funded by government, the RSNZ was (and is) not an adversarial pressure group. It has always been keen to provide constructive ideas for government. In addition, the manifesto was launched under the RSNZ presidency of a tech entrepreneur (Sir Gilbert Simpson), which might also help explain its particular interpretation of the purpose and positioning of public research as the key to economic diversification and prosperity.

Yet another factor that might have contributed to this interpretation, however, may be found in the broader context of the time. A contentious debate on genetic modification

[41] Issues it raised included lack of career progression, lack of full cost recovery to support and maintain university research infrastructure, lack of long-term predictable funding for ideas and innovation.

[42] By this time, the "systems of innovation" concept was being promulgated by the OECD. This approach discouraged governments from trying to predict and support promising industries (i.e., 'picking winners'), and instead to concentrate on the broader conditions for innovation to occur.

was dominating public discourse in New Zealand as the Royal Commission on Genetic Modification was due to report its findings in July 2001. Prominent voices within the research community saw the importance of establishing public acceptance to at least allow scientific exploration of the safety and supposed promise of new genetic technologies. This was later to translate into the report's main theme of cautiously "preserving opportunities" (Key Informant interview). Thus, a science manifesto highlighting technology and innovation drivers of wealth may have expressly anticipated the Commission's later report.

The snap election of July 2002 further stirred the GMO debate as an investigative journalist published an election-timed book claiming government had covered up a GMO seed contamination error (Hager, 2002; Norrie, 2002). Meanwhile the government had yet to respond to the Royal Commission's recommendations, while Anti-GMO public protests brought strong Māori voices into the debate. However, the incumbent Labour party's election win was again no guarantee for a resolution of issues or stability in the public research sector. Instead, government became even more interventionist (Key Informant Interview). Their renewed mandate allowed them to continue their higher education reform agenda, announcing the establishment of the new PBRF scheme in 2002 with the initial review of universities' research performance to be held in 2003.

The budget of 2003 signalled the government's more explicit interest in the public research sector compared to any previous government. The budget's so-called "Growth and Innovation Framework," which had been introduced during the election, set the tone for its plans to mobilise the sector by focusing on the emerging innovation for a "new knowledge-based economy"(Cullen, 2003; Cunliffe, 2004).

This interpretation of the purpose and value of public research was in keeping with international discourse advanced by the OECD, which compared measures of countries' innovation framework conditions including (and especially) the state of their public RSI sectors. Such international benchmarking served to construct and reproduce the shared assumption that the overarching goal of public research is to advance national competitiveness through innovation in a 'knowledge based economy' (Godin, 2004; OECD, 2003). Indeed, the OECD's role as a significant transnational actor in establishing the public RSI governance paradigm as the engine of innovation and national competitiveness has been well-documented (Henriques & Larédo, 2013b).

The ideational shift toward the Growth and Innovation Framework was supported operationally by the government's establishment of a new policy actor – New Zealand Trade and Enterprise (NZTE) – to advocate for industry and to foster ties between public and private research regime players. Notably, the framework also prioritised three sectors for special support: Biotech, Information and Communications Technology (ICT), and Creative Industries. However, in stating these priorities, the government insisted it was not 'picking winners' or abandoning traditional rural economic concerns (Anderton, 2003; Swain, 2002). Indeed, the Tertiary Education Commission was instructed to establish a slate of working groups on all other industrial sectors (including and especially traditional ones), to support their growth needs through the tertiary education, research and technological development.

Significant domestic actor begins to question paradigm legitimacy

Government's hopes for New Zealand's biotech sector were soon in question with a second anti-GMO protest since the Royal Commission's report. Notably, this protest was organised by Māori leaders and communities. The Māori stake in New Zealand's innovation

future was asserting its own perspective, which differed from the government's at the time. Whereas previously, the commitment to Māori within the RSI sector found expression in education and training, now it was the social and moral implications of research and innovation that were foregrounded, with Māori communities leading the way toward more considered thought and action (M. Hudson et al., 2019; McGuinness et al., 2008).

Indeed, it was becoming clear that, despite many CRI and university-based researchers engaging and co-designing projects with Māori collaborators over the years, any ideas about New Zealand's knowledge-based future would need to be responsive to, and to engage with, Māori in a more systematic way as part of the paradigmatic social contract for public research in New Zealand. Thus, with another slim mandate for Labour in 2005, MoRST (the science ministry) now sought to attend to this uniquely New Zealand question on one hand, while on the other, turning outwards to seek transnational advice and to position the New Zealand knowledge sector globally.

Addressing the former, MoRST's launch of the Vision Mātauranga (VM) policy statement in 2007 marked the beginning of a new way of undertaking public research, which profoundly adapted science's social contract (MoRST, 2007). Written by Māori scholars, but still within the dominant paradigm of the day, VM was designed with the aim to "unlock the potential" of Māori knowledge, capabilities and resources through the appropriate application of science and technology in dialogue with Māori worldviews. VM has survived successive governments and changes to administrative machinery of the research governance regime. It later come to form the basis of a funding tool to support and enable Māori scholars and communities through research and innovation, the Vision Mātauranga Capability Fund. In addition, the principles it lays out would become an enduring component of all contestable

funding applications in New Zealand (Key Informant Interview, New Zealand government official).

However, as will be discussed later in this section, a post-2020 Public Service reform would emphasise Treaty of Waitangi-based partnership ideals between Māori and the Crown, leading to calls for much more substantive governance reform to decolonise all public policy sectors including RSI. A VM policy and funding mechanism that was bolted on to the RSI system would come to be seen as insufficient for the type of fundamental transformation sought by Māori scholars and leaders (Te Pūtahitanga Collective, 2022).

External actor's advice and ideas serve to legitimise change

From the transnational perspective, the government invited the OECD's S&T directorate to assess the public research and innovation system, as it became concerned with performance against comparative international benchmarks for competitiveness (OECD 2007 and Key Informant Interview, Ministry official). Besides turning to Britain and Australia in the design of the PBRF, New Zealand had rarely looked abroad for systemic advice. This is perhaps unsurprising given the specific and targeted ambitions that successive governments had held for public RSI up to that point, to serve the traditional industrial base and provide regulatory knowledge unique to the ecological region. However, a a MoRST staff member who had previously been seconded to the OECD helped initiate an OECD review exercise among ministry staff (Key Informant Interview). Indeed, in a new era of knowledge-based global

competitiveness, external ideas were increasingly sought out within the New Zealand public service.[43]

As it happened, the OECD reviewers were quite critical of MoRST and FoRST's focus on short-term transactional research and the zealous embrace of the Principal-Agent theory of research funding without long-term strategy or conducive policy settings. They critiqued the fragmented system and made recommendations on incentives for innovation and commercialisation (OECD 2007; McGuinness 2010; Gregory 2016; 2017). It was left to incoming Science Minister Peter Hodgson[44] to act on the review's findings, but the government was heading towards an election and RSI was not a hot topic of public concern (Gregory, 2016). A senior CRI researcher summarised the time:

> It got worse and worse, ministers had no interest in science, so it was allowed to morph, and you can see how the system go so confused. Now we have agencies funding their own science, like the Department of Conservation. These were the very ones that were streamlined into the Foundation in the first place. So, the structure devolved into small pools of money. In 2008 the system had become so wrecked that the RSNZ set up an expert panel (Key Informant Interview, former panel member)

As the Royal Society had pointed out these issues seven years earlier, it now sought to refresh its advice. It struck the National Science Panel in 2007. Comprising elite researchers from a variety of disciplines, the panel produced (another) 'Science Manifesto' which made

[43] It appears not to be uncommon in the New Zealand public service to find functionaries who have spent time at one of several multi-lateral agencies of which New Zealand is a member, or to find foreign nationals employed within the New Zealand government and bringing experience and expertise from similar positions overseas. This mobility of expertise enables inflow and cross-pollination of policy ideas including whole framing perspectives.

[44] Hodgson's predecessor, Steve Maharey stepped down to accept a role as a University Vice Chancellor.

ten key recommendations the following year[45]. The final recommendation is worth quoting in full because it encapsulates the enduring belief in the Scientific Freedom paradigm, which was shared by both CRI and academic researchers, but clearly not by their government funders:

> As a nation we need to rebuild trust in our research institutions and our scientists. This means devolving greater decision-making responsibilities to the science agencies and allowing them to engage in creative work with less interference. It means providing long-term funding for public good science, leading to appropriate career stability and prospects. It means promoting cooperation rather than competition, and it means assisting scientists' development, particularly early in their careers. (National Science Panel, 2008).

By the time the new Manifesto was launched in April 2008, the Royal Society had a new President who prioritised other projects (Key Informant Interview, former panel member). The National Science Panel therefore undertook its own publicity and the Manifesto gained attention, nonetheless.

The New Zealand Association of Scientists, a national body that had grown from roots as public service scientists' trade union in 1940, applauded the manifesto (NZAS, 2008). More support came from 2500 staff members of the country's nine CRIs in a rare public comment about their own situation (PSANZ, 2008). Panel chair Jim Watson's opinion piece in the New Zealand Herald just ahead of the 2008 election, once again called on government to heed the Manifesto and OECD recommendations. Notably, Watson encouraged the government to

[45] The recommendations were to: develop a national science strategy; appoint a chief science advisor; enhance innovation policy and programs; ensure government policy is evidence based; reduce compliance and transaction costs for scientists and develop science policy and analysis expertise; invest more public and private research; enhance the path to commercialisation; promote science across the education system; promote the public value of science; and trust scientists and scientific institutions

follow through on its innovation aspirations, while also advocating on behalf of the research community that it be trusted and well supported (Watson, 2008). The inherent tension between these goals was either overlooked or ignored in a bid to capitalise on Treasury's attention to the sector while minimising the associated policy and managerial attention that had characterised it for the past several years.

The 2008 election resulted in a right-leaning National Party led government in the midst of global financial meltdown, although the impacts of the financial crisis did not hit New Zealand immediately. Over the course of the next three parliamentary terms, National implemented the Manifesto's recommendations, having included these in the party's election platform of 2008. This move appeared counter to global trends among conservative governments prior to the Global Financial Crisis (GFC), which had been variously accused of undermining public science.[46] However, when viewed against the changing material conditions left by the financial crisis, National's support for science is consistent with a view of public science as a promising driver of innovation and therefore economic development. This was a norm that the OECD review had previously helped establish and one – in the context of the GFC – the research community seemed ready to accept if it meant not cutting public research budgets.

[46] In some international jurisdictions, particularly where there are dominant interests from extractive or obviously harmful industries (mining, fossil fuels, tobacco) it has been shown that the political Right had enabled or overlooked systematic campaigns to undermine public interest research that could expose harms. For instance, the actions of the George W. Bush government in the United States, and later Stephen Harper's Conservatives in Canada would weaken and shutter federal regulatory science, leading to accusations of 'muzzling' and the establishment of NGOs such the Union of Concerned Scientists in the US and Evidence for Democracy in Canada (CBC News, 2018; Turner, 2014; Union of Concerned Scientists, 2004).

6.4 (2009 – 2014) Focus on Economic Competitiveness and Prosperity

When the government formed post-election, the first recommendation to be implemented was to appoint Science Panel member, Sir Peter Gluckman, as the inaugural Chief Science Advisor to the Prime Minister (CSA) from July 2009 (The University of Auckland, 2009). Gluckman came to the position with government relations experience, having established the Liggins Institute at the University of Auckland. He knew that to advocate strictly for the Scientific Freedom paradigm could see him quickly side-lined by government, especially in the context of global economic anxiety (P. Gluckman, 2014; P. Gluckman & Wilsdon, 2016). Instead, the new CSA carved out a role as a transnational ideational broker (Schrad, 2010; Skogstad & Schmidt, 2011). He worked to position public research more centrally, not just for a 'resilient economy' – as had been the prevalent government discourse – but more broadly for a 'resilient and innovative economy and society' (O'Connor & Harland, 2014).[47] His importing of the language and ideas from an international community of practice tried to balance the economic framing of public science with the globally evolving societal framing. The emerging framing stands in contrast to the governance paradigm he was brought into as inaugural CSA.

(Re) stabilising the paradigm: An inaugural strategic plan

The public research regime entered its third decade of ongoing and highly contested changes in 2009, and still without any serious commonly held vision for the sector, which appeared instead to be driven primarily by a combination of both material and ideational path

[47] Whereas the OECD assessment exercise had made recommendations for improving the New Zealand system based on international benchmarks, a national science advisor has local knowledge of what is relevant in context and can better translate international policy lessons and ideas.

dependency, punctuated by the political desire to harness the sector's instrumental promise. Not even the role of the CSA was clearly articulated by the government that instituted it (Key Informant Interview).[48]

Given the mixed record of systemic reforms to date, the background of the Global Financial Crisis and the newly elected pro-business government, it may have seemed obvious that the CSA role would be interpreted in the context of innovation policy. Indeed, as with most OECD member states in the early post-Financial Crisis period, in New Zealand, 'innovation' was beginning to eclipse 'science' and 'research' in the vocabulary of officials in the research governance regime (Leitch et al., 2014).

Yet the National Science Panel's Manifesto was the informal playbook for the new Chief Science Advisor in which 'innovation,' 'science' and 'research' were decidedly separate but interdependent functions (Key informant interview, former government advisor).[49] This playbook set the stage to deal with the enduring problem of transactionalism and short-term commercial focus within the CRIs. The CSA prompted reflection on the issue with the release of a paper that expanded the Science Panel's arguments and laid out a vision for translational research and innovation (P. Gluckman, 2009). The government's response, in part, was to establish a task force to consider the issue in more depth. The task force was chaired by

[48] The role derived loosely from the UK system, which was a far more elaborate and established office, with formal institutional links to departments, cabinet office and the national security mechanism. The UK institution of Chief Science Advisor had dual roles in advising on governance and funding for RSI (policy for science), while also providing scientific advice for public policy.

[49] Typically, the functional distinction in these terms holds that government 'science' provides necessary knowledge to meet regulatory and policy making obligations, 'research' is aimed at discovery and knowledge creation while 'innovation' seeks to apply knowledge in new ways, often for commercial and economic opportunity, but may also be applied to areas of public policy-making.

Neville Jordan, the former President of the Royal Society, who two years earlier had discontinued the Society's work on the Science Manifesto.

In March 2010 the *Jordan Report* on "How to enhance the value of New Zealand's investment in CRIs" was launched (Jordan, 2010). Of its many operational recommendations, the most systemically significant was to reduce the competition and transactionalism that characterised the sector by simply re-profiling contestable funding to core funding. CRIs would be required to conduct themselves to the standards of board-directed companies to maintain accountability, but financial security would allow more focus on strategic contracts and public responsibilities.

A few months later these recommendations were included in New Zealand's inaugural strategic plan for public research, science and innovation. Entitled "Igniting Potential: New Zealand's Science and Innovation Pathway," this inaugural science and research strategy was described by the presiding Minister, Wayne Mapp, as "the greatest transformation of the science system since the CRIs were introduced in 1992." (MoRST, 2010)

The strategy's launch was a step toward stabilising and embedding a paradigmatic discourse that clearly articulated for the first time the perceived separate functions of the public research system: regulatory monitoring and evaluation, knowledge generation and innovation. At the same time, the strategy was also a discursive tool to frame a certain perspective and amplify certain goals for public research, at the expense of others. This effect of the strategy becomes clearer in retrospect, and by comparing successive strategies. Notably absent from the strategy was any meaningful engagement with Māori worldview or

aspirations for the RSI sector. This would not make an appearance until the third national RSI strategy, over a decade later.

The two overarching goals of 'Igniting Potential' were to simplify the small but complex funding and governance arrangements, and to support priority areas that spanned the spectrum from 'public good' to 'innovation.'[50] In addition, while the strategy addressed the well-known damage that competition, transactionalism and managerialism had done to CRIs, it also emphasised the need to raise the public profile of science and innovation in New Zealand.

Discursive framing: A small country in global perspective

Framing New Zealand's research sector as "potential unrealised," the inaugural national RSI strategy positioned the sector as a resource to be developed for the "benefit of New Zealand," thereby implying its un(der)developed nature to date. This framing derived from explicitly viewing New Zealand in a comparative global context, thereby distinguishing it from previous research policy discourse, which had focused inwardly on knowledge needs in the national context. Such international comparison generated a self-awareness of "size, geography, environment, sociology and economic structure" that, it was argued, needed to be taken into account in setting policy (Ministry of Research Science and Technology 2010 p.9). It also aligned with the new conservative government's concern for national competitiveness in a global market.

[50] These were: high-value manufacturing and services; biological industries; energy and minerals; hazards and infrastructure; environment; health and society

This approach mobilised the notion of New Zealand's uniqueness as a discursive tool. It implicitly built a collective understanding by looking at the system from a global perspective rather than strictly looking inward at its own internal dynamics. More generally at the time, that same collective vision was emerging in the New Zealand Trade and Enterprise agency's (and government's more generally) concept of the *"New Zealand Inc*" (Hamilton-Hart, 2021). This term was the branding device used to bring together New Zealand's government entities that focused on foreign and trade policy, and to project an image of the country (to itself and internationally) as a productive, prosperous and internally coherent firm (NZTE, n.d.; A. L. Smith, 2019). Working in tandem with the government's underpinning "Business Growth Agenda", *NZ Inc.* was the lens through which the government considered its overall policy agenda, including for the RSI sector. High on its list was to support and grow traditional export industries while also helping diversify toward high-value new ones. When applied to the public RSI sector, this policy lens revealed an apparently untapped resource to help achieve the agenda (Joyce, 2012a; MBIE & Treasury, 2012). As such, reform and intervention in the sector would only increase in a continued effort to replace transactionalism with strategic intent.

Installing new actors to match the new framing

The enhanced interest in RSI as a pillar of the government's Business Growth Agenda was made evident in the extent of changes it would bring to the sector in the next few years. By December 2010, for instance, the government had fully disestablished MoRST and FoRST and instituted a new Research Science and Technology Act (Research, Science, and Technology Act, 2010), under which it created a new ministry. Coming into effect in February 2011, the new ministry was founded with a name that signalled the new intent and

expectations of the sector. the Ministry for Science and Innovation (MSI) effectively re-coupled the policy and funding functions under a single entity[51]. At the same time, an unprecedented international commitment was made to help found and support the Global Research Alliance on Agricultural Greenhouse Gases (GRA, n.d.). This multi-lateral grouping directed national funding toward international agricultural research sector and gave government a platform from which to demonstrate international scientific leadership that could effectively meet both industry and public interest imperatives.

Attending to CRI structural tensions would have to wait, however, as material imperatives intervened. The devastating Canterbury earthquakes, between September 2010 and February 2011, resulted in an understandable shift in Government's budget priorities. However, the shock also served as an apt reminder of the importance of research in the public interest, such as contextually specific geoscience and natural hazards research, provisioned most often by CRIs.

It is unclear whether the earthquakes played a role, but a rumoured downsizing and merger of CRIs did not eventuate (New Zealand Herald, 2011). Instead, a taskforce on CRI restructuring would lead not to a merger but to the establishment of a new institutional player dedicated to innovation. Absorbing the most industry-facing of the CRIs, the new innovation agency was designed as a one-stop-shop to encourage research by industry and to foster a community of start-ups (Raine et al., 2011).

[51] For allocation of funds, MSI established a Science Board to avoid any perception of conflict of interest over government's potential to influence expert assessment of funding applications.

The appointment of a university researcher to chair this task force with such high stakes for CRIs might be read as a strategic master stroke to better integrate the system, but whether or not the intention was to build acceptance for the merging CRIs into universities as Denmark had done a decade earlier is unclear. Regardless, the new innovation agency now provided a central point in the system that helped to clarify the muddled functions of other institutional actors, thereby relieving some of their pressure on others to service industry.

The Ministry of Science and Innovation proved to be short-lived. On the retirement of its inaugural minister, at the end of 2011, the job was filled by Minister Steven Joyce whose pro-business (i.e., '*NZ inc.*') interpretation of the social purpose of public research encouraged government to bring together the Industry, Science, Labour and Housing portfolios under one super-ministry. The new Ministry of Business, Innovation and Employment (MBIE) opened on July 1, 2012 (Joyce, 2012b). Citing similarly merged ministries in the UK and Australia as precedent and justification, the government's media release made no mention of the erasure of 'science' in the new ministry's title:

> If we want more and better jobs for New Zealanders, we need to encourage more businesses to be based here. That means making it easier for businesses and companies to access innovative ideas, markets, capital, skilled workers, resources, and the supporting public infrastructure. The Government has a comprehensive business growth agenda to assist business, and a single focused business-facing government ministry will further boost our momentum. (Joyce, 2012a)

This was a significant organisational restructuring for public research, which was now placed more fully within the business and innovation portfolio, consistent with the government's approach to governing under its 'Business Growth Agenda.' It clearly signalled the government's perception of the primary purpose of the public RSI sector, despite still holding the budget for public interest and regulatory research within the same portfolio. NZAS

had been drawing attention to these potential conflicts and tensions as the growth of export agriculture was by now having a demonstrably negative impact on the environment and freshwater ecosystems in particular. The NZAS publicly questioned how free CRI researchers were to raise concerns about the environmental impact of industry and how scientists could reprioritise the non-economic value of science. It would feature as the theme of their upcoming annual conference (NZAS, 2013).

Destabilisation through contrasting images

If the inaugural national strategic plan for RSI (2010) and new organisational structure were built on the conservative government's self-image and idea of New Zealand as a small, innovative country ("NZ Inc.") on a global stage, this perception was nonetheless fragile despite its paradigmatic features. In November 2012, for instance, MBIE was looking forward to capitalising on the release of the NZ-made motion picture, The Hobbit, which had benefitted from considerable public investment in creative industries' innovation. It was an historic moment that put on global display NZ's artistic and technical talent and extraordinary natural environment (which the Ministry of Tourism had labelled "Clean, green and 100% pure"). However, the New York Times published an article that contrasted the green and optimistic image of the country to the realities of growing human environmental impact (Anderson, 2012).

Significantly, one of those interviewed for the New York Times story was Dr Mike Joy, a freshwater ecologist, then based at Massey University. Joy was critical of the government's crafted national image and pointed out how New Zealand was instead failing to meet international environmental standards (Bradshaw et al., 2010). Joy polarised public and leadership opinion, and was labelled variously as a traitor by some governing elite, and a hero

by others in the research community, particularly within NZAS (NZAS, 2012; Shadwell, 2012). While much freshwater science in New Zealand is undertaken by CRI researchers, it is not within their scope to offer their opinion on policy issues. By contrast, Joy's 'critic and conscience' role as an academic provided a platform from which he could expose what he saw as systemic conflicts of interest within the science system, as it attempted to serve both industry and the public interest (Joy, 2015).

Thus, whereas previously any values-driven questions in RSI governance and funding had been largely about resource allocation, now changing environmental and material conditions were exposing much deeper values-based arguments about the social purpose and therefore the governance of a publicly funded research system. And this was changing the conditions of legitimacy for the emerging governance paradigm.

The discursive mobilisation of 'small'

The ongoing debate also exposed two very different perceptions of New Zealand that were linked to the notion of size. On one hand was the government's desire to position NZ in a global context as a "small country, punching above its weight" in competitiveness and innovation. On the other hand, was an environmental perspective that, by definition, was inward-looking and localised to communities, regions, right through to specific river catchments and traditional territories of the Māori people. The former perspective was exemplified by the New Zealand government's investment in the establishment of the Small Advanced Economies Initiative (SAEI) and the 'NZ Inc' approach to governance (Brady, 2019;

Joyce, 2012c). The latter perspective could be seen in the rise in mainstream and government discourse of *Kaitiakitanga*, [52] a Māori concept meaning stewardship of the land.

For its part, the SAEI was established 2013, under the joint auspices of the Office of the Chief Science Advisor, MBIE and the Ministry of Foreign Affairs and Trade (MFAT). Intended as a community of peers to share policy ideas and intelligence relevant to small countries, the SAEI brought together NZ, Denmark, Ireland, Singapore, Israel and Finland to learn from each other and project a voice for small advanced industrial economies on a global stage. For NZ, unattached to either the G7, G20, or to the EU, the SAEI was an institutional innovation which made it easier to access informal ideational networks globally, and to broker between public research and policy communities, as well as between national and international actors in science, research and innovation policy[53]. The group was primarily interested in learning from each other's RSI systems for economic development and competitiveness, making it a highly influential space for transnational reinforcement of the research governance regime's dominant paradigm.

[52] The Māori concept of *Kaitiakitanga* (stewardship of the land) first appears in mainstream institutional usage in the Resource Management Act (1991) as a legal concept carrying administrative responsibilities to keep land use records. According to Google's Ngram tool, the popular use of the term grew in the late 2000s and early 2010s before beginning to decline. This timing coincides with the rise of public discourse around the environmental degradation due to intensified dairy and beef farming practices. This is not to suggest that the issue was divided along cultural lines (indeed 30% of all beef and lamb production are Māori owned, and Māori have some $13B in agricultural assets. Moreover, much of the term's usage came from government itself). Rather, it is mentioned by way of contrasting two very different discursive images of New Zealand that each mobilised by different communities in different ways to rally support.
https://ourlandandwater.nz/news/how-maori-agribusiness-is-leading-aotearoas-farming-future/

[53] e.g., the OECD S&T Directorate, the European Commission's Directorate General for Science UNESCO, and the International Science Council.

But drawing regime-shaping lessons and ideas on innovation from international peers seemed far removed from the localised *Kaitiakitanga* responsibilities, among other distinctly local needs, that were equally important in the New Zealand context. Indeed, as an international community of practice, the SAEI could offer no advice on ways to meaningfully give effect to New Zealand's *Tiriti o Waitangi*[54] obligations. Nonetheless, the RSI system continued attempts to reflect and service both the inward and outward looking perspectives. It translated international ideas within the distinctive national context of New Zealand through a mix of funding schemes and the institutionalisation of ex-ante impact assessment with, increasing emphasis on Māori communities and economic development.

Yet the material insufficiencies of the small country context continued to be perceived as limiting by ministry officials, thereby entrenching conflicting ideas about the social purpose of public research and how to achieve it. On one hand, the tension between academe and government seemed amplified:

> We have way too many of our [academic] researchers who are doing research that someone else is going to do. We don't have enough doing work on New Zealand specific problems. A classic example is health disparities in New Zealand. Who is going to focus on New Zealand's health disparities but us? Yet we have hundreds of our researchers being part of international collaborations where this is going to make no real difference. It's a real struggle to get researchers to focus on what we need […]. If we were a big country, then we might get a lot of return on that [putting effort into international collaborative research]. But as a small country, what kind of return on investment do we get? Probably none, leaving aside the knowledge transfer to students. It's research that is going to happen [globally] anyway. (Key Informant Interview, former government official).

[54] See section '2020 onwards' in this chapter. Tiriti o Waitangi is the Indigenous language version of the Treaty of Waitangi, which was intended to set out the governing arrangements between Māori and the Crown . Māori and Crown representatives still disagree on which is the official version. In 2020, changes to the State Services Act (renamed 'Public Services Act') aimed at a more equitable Māori-Crown relationship in all aspects of New Zealand governance including in the RSI sector.

At the same time, these same policy actors held the expectation that universities are to be engines of innovation, especially given the relative lack of research-intensive industry in New Zealand and the apparent path dependency of the CRIs:

> The issue of economic diversification is interesting because the CRIs are locked into the same course. It's completely historical because they were set up based on our [economic] strengths, which were around primary industries and the environment. So, if anyone is going to help with economic diversity, it's not going to be the CRIs that do it. It's going to be the universities. (Key Informant Interview, former government official)

Ironically, for universities to achieve that innovation potential, their need to engage with broader international perspectives was nonetheless clearly recognised:

> We need to start thinking of ourselves as an Asia-Pacific innovation system, not just New Zealand, because we are not otherwise connected, like within the EU. But there is no vision for it here. It may be recognised but how willing is any government to take those risks? (Key Informant Interview, former government official).

This lack of internal logic and coherent vision – either for the role of different research actors, or for the breadth of their scope – reveals the key tensions in a fragile RSI governance paradigm. This seemingly untenable conceptualisation of public research in New Zealand seems at least partially due to how the material context New Zealand's small size was being interpreted by the innovation-focused ministry.

Transnational ideas in the New Zealand context

Although the contrasting perceptions of small size exposed the different imperatives for public research, other SAEI member states argued that their small size is what allowed them to nimbly trial and assess new research policy ideas from the global policy commons (Key Informant interview, SAEI representative).

By 2012, one such idea circulating among SAEI members was the concept of 'challenge-based' research platforms that directed substantial funding toward well-articulated problems that could not be fully tackled by a single discipline or methodology. These research governance and funding structures tended to be directive only in the identification of the general challenge, but the rest was left to the research community to determine the most promising approaches and what it would take to operationalise them. SAEI members were exploring the challenge format as a middle ground between impact-driven and investigator-led research. It was a tension that the government was keen to address with this hybrid government-directed Scientific Freedom approach (Key informant interview, SAEI representative).

Informed by the SAEI's discussions, the New Zealand CSA recommended that MBIE launch an NZ version of a challenge-based funding scheme. The idea was expected to offer a way for the ministry with the science budget to have some reach into the academic community "to correct the structure", in return for which – it was hoped – government "would inject more money into the system" (Key informant interview, SAEI representative)

Thus in 2013 *The Great New Zealand Science Project*[55] began with a short media campaign to solicit public opinion on what should be the big issues for experts to tackle. Videos of practicing scientists explaining their work to school children ran in advertising slots on television and in social media. Seven challenge scenarios were pre-identified by the

[55] See https://www.youtube.com/user/GreatNZScience

Ministry, and public votes for these were accepted through the website.[56] It was clear from the outset that the public awareness-raising goal of the project was foremost. Any serious effort at public consultation would have required more structure and time to operationalise.

In the end almost all of the Challenge topics were selected[57]. However, while the program was intended expressly to foster more collaboration across the divide between Universities and CRIs, the unexpected number of challenges endorsed by the Minister meant that competition for the limited funding for each challenge became even more intense. Moreover, the number of regime actors multiplied in the form of Challenge governance and scientific advisory bodies. Added to this was the problem that the funding that had been recently earmarked to support the core activities of the CRIs now would be allocated to the Challenges, rather than injecting still more new money into the system (Key Informant Interview, Science Policy Expert). What was intended as a galvanising activity to bring coherence and collaboration risked having the opposite effect. Material funding insufficiencies again prevented the development of a shared vision for the RSI system.

> People talk about the 'science system.' I don't think there is one. I don't know how we are supposed to interrelate. I sit around with people in all these splinter groups created by the different organisations and Challenges, desperately trying to figure out how we are supposed to co-exist. How does it all fit together? So, if we get a real issue

[56] These were: Our Rich Seas; Our Changing Climate; Fighting Disease; Land and Water; Foods for Health; Protecting Biodiversity; and Resilience to Natural Hazards

[57] The exception was 'Our Changing Climate' which was not retained for funding. Other noticeable differences between the campaign suggestions and the final suite of Challenges included the renaming (and discursive reframing) of "Our rich seas" to "Our sustainable seas" and "Fighting Disease" being given more scientific specificity by separating it into three developmentally based Challenges: "A Better Start", "Aging Well" and "Healthier Lives."

> in New Zealand[58], we have to figure out who we are supposed to work with, and then we go to the relevant ministry who doesn't seem to know any of us exist. And it's hugely competitive. I think the science system has unravelled. (Key Informant Interview, New Zealand emeritus scientist)

Reinforcing a contested paradigm: constructing practice standards

One area that did receive new (but unplanned) funding from government was the so-called 11th National Science Challenge, which was not aimed at the research community at all. Launched in 2014 under the banner *A Nation of Curious Minds* (NOCM), this challenge was designed as a platform for school-based science 'outreach' and participatory research, aimed at regional organisations (e.g., museums, economic development agencies) to run localised funding processes to support small community-based research projects with low barriers to entry.

As a nation-wide publicly funded participatory science programme for the public, the scheme was globally innovative. However, its interpretation of 'civic engagement' was given effect as citizen-science and promotion of STEM, rather than a more systemic engagement aimed at enhancing the democratic role of knowledge generation and its application for decision-making in society (MBIE, 2014a).

One activity within NOCM did address a more systemic level. Under the aim of public engagement, was the suggestion that a Code of Conduct for Researchers be developed by the

[58] This interview was conducted prior to the Covid-19 arriving in New Zealand. The respondent was referring primarily to biosecurity risks (invasive pests) for the conservation and agricultural sectors. However, the pandemic nonetheless did reveal RSI system weaknesses in the lack of dedicated research agency on infectious disease and public health. University-based researchers did manage to coordinate quickly with CRIs with which they might not normally have interacted. For their part, CRIs managed to repurpose research programs to serve public health analytical needs at the height of the pandemic.

Royal Society in close consultation with the RSI community of practice. There had been several such Codes developed internationally over the years, in particular to combat poor or fraudulent publications (e.g. World Conference on Research Integrity 2010). In New Zealand, there had been no evidence of such fraudulent practices, instead it was public communication that was the main consideration. According to the Chief Science Advisor, if NOCM was going to encourage researchers to be more engaged and vocal, then it should provide some guidance on how best to do so. However, the suggestion caused concern within much of the research community, which was already sceptical of the current government (Allison, 2014).

To be sure, recent disasters in L'Aquila Italy and Fukushima Japan had brought the issue of communicating scientific risks and uncertainties to the forefront in an effort to structure a platform for scientists to speak publicly (Ropeik, 2011, 2012; Science Council of Japan, 2013).[59] In New Zealand however, by late 2014, the suggestion of any Code of Conduct developed within a government scheme was met with scepticism in the research community. The NZAS took the idea as an alarming sign of overt control by government, particularly when perceived in conjunction with what it saw as the already limited public transparency experienced by its members employed in CRIs. NZAS was sufficiently concerned that it launched a survey of NZ researchers asking, among other things, "Have you ever been

[59] Specifically, it advised scientists that policy-making should not be expected to be fully evidence-based, but that: "[i]n the event that a policy decision is made that diverges from the advice of the scientific community, scientists shall request as necessary, accountability to society from the policy planner or decision maker."

prevented from making a public comment on a controversial issue by your management's policy, or by fear of losing research funding?" (Wiles, 2015).[60]

The NZAS reported that of 384 responses received, 151 people answered 'yes' to that question in 2014. However, no analysis was provided in terms of the type of research at issue, nor legislation (CRI or Universities Acts) that it would come under. Findings from the survey nonetheless prompted the NZAS to feature "Scientists Speaking Out" as the main theme of their annual conference the following year (Meduna, 2015; NZAS, 2015).

If, by launching its (2010) national strategic plan for the public RSI sector, the government had begun a process of consolidating and embedding a paradigmatic governance vision, clearly it was not yet shared or fully legitimised among all sector actors and pressure groups. At least not the full breadth of the proposed plan. Its interpretation of the social contract – how public accountability and responsiveness should be given effect – was still contested. There continued to be differing views on the degree of openness and transparency that should be expected of researchers holding different functional roles with the RSI system – specifically those employed within CRIs.

> There have really been two systems in New Zealand – the Universities and the CRIs. And MBIE really has no leverage over the Universities […]. We are not really affecting that system, but there is definitely a sense of wanting to and needing to in a small country. (Key Informant Interview, MBIE official)

These differences were further entrenched by institutional conditions requiring CRIs largely to self-fund through commercial contracts, thereby exacerbating tensions between

[60] Including the NZAS membership and the NZ public research sector more broadly (universities, CRIs).

their public and private sector roles, and between the role of CRI researchers and that of academics, as both the CSA and the NZAS had previously pointed out.

6.5 (2015 – 2019) Paradigmatic Tension: Competitiveness and Social Values

Competing material imperatives: the continued struggle for a common vision

During this period, an ongoing tension between the health of freshwater ecosystems and the primary industrial sector that underpins New Zealand's export economy (especially dairy) provides a compelling example of the contested nature of the research system governance paradigm. This tension had been a significant background public-interest issue in New Zealand leading up to the NOCM strategy. The Parliamentary Commissioner for the Environment had released a report in November 2013 on water quality, land use and nutrient pollution (Wright, 2013). When the right-leaning government released its National Policy Statement for Freshwater a few months later, some in the academic community were particularly concerned about its framing, which suggested "bottom line" acceptable standards for water quality rather than aspirational goals and specific targets (MfE, 2014).[61]

It was against this backdrop, as well as the proposed Code of Conduct for Researchers engaging with publics, that the NZAS had launched its survey. Implicit in this exercise was the NZAS' impression that CRI researchers especially, due to their institutional positioning and

[61] Three years later, the conservative government amended their National Policy Statement to provide more detail on measuring standards (which it acknowledged would fluctuate with the seasons) and to state explicitly that 'bottom lines' are not 'targets', but in fact their opposite. The amended statement also gave more explicit attention to *Mana o Te Wai,* which can be defined as the inherent authority of rivers in the Māori worldview

governance arrangements, were unable to truly serve the public interest through research if they were simultaneously contracted to industry. The further implication (which the CSA also would later emphasise) was that two of the country's dominant values – primary sector industries on one hand, and the country's unique and vulnerable ecosystems on the other – could no longer co-exist comfortably in parallel (P. Gluckman, 2017). Instead these values were increasingly forced into tense entanglement, particularly with the increase in conversion of wild and rangeland to pastoral land over the course of the previous decades (MacLeod & Moller, 2006; Snelder et al., 2021).

Within this tension is embedded the enduring question at the heart of New Zealand's paradigmatic struggle within its public research system: What types of impact should be expected from public investment in RSI (NZAS, 2013; O'Connor & Harland, 2014)? Certainly as a small country, economic diversification was high on the list of aspirations and expectations, but so too was "stewardship science" for Kaitiakitanga (P. Gluckman, 2022). Yet, the country's geographic distance from any major global innovation centre meant that investment in innovation would continue to fall primarily to the public sector as it was difficult to attract private investors from diversified knowledge-based industries overseas. Conflict in investment priorities continued (Treasury, 2016). Paradigmatically, a shared understanding of the research systems relevance and public accountability remained unresolved.

Re-writing the social contract: The effects of a new national strategic plan for RSI

In 2014, MBIE launched a consultation on a new national public science and research strategy[62] just 4 years after 2010's inaugural 'Igniting Potential' strategy and under the same conservative government (Joyce, 2014). A new national strategy could now be directly tied to the government's overarching Business Growth Agenda policy rationale however, with focus on simplifying the contestable funding elements of the system and amplifying its business-facing features (MBIE, 2014b). In other words, a system that was already end-user driven was set to become even more so, with the hope of seeding businesses' own expenditure on research and development, which had been a missing piece in New Zealand's RSI system due to lack of major knowledge-based multinational industry.

Entitled *National Statement on Science Investment* (NSSI) the 2014 draft strategy was the clearest signal yet of the conservative government's interpretation of the purpose and value of public research in New Zealand, which it implied, would link directly to productivity. However, this implication did not appear to consider the structural institutional and material obstacles that had long impeded industry investment in research and development in New Zealand. As the CSA had pointed out, there was simply not the industrial mix of large science-driven firms in New Zealand to create an ecosystem of research activity around them. When home-grown knowledge-based industries did emerge, they would reach a certain size only to be tempted by the Silicon Valley, for instance (P. Gluckman, 2011).

[62] The design principles for the new "National Statement of Science Investment," were to: increase government investment in public research; apply a 'rigorous test' for the value and impact the funded science is expected to create; use investment levers to incentivise industry to undertake research; and prioritise likely growth areas. These were identified as: high value manufacturing and ICT, health care and social services, high value primary products, and "environmental innovation for sustainable production and biodiversity protection (MBIE, 2014b)

Furthermore, the new draft national strategy contrasted with its predecessor. Inspired by the researcher-led Manifesto, the inaugural strategy four years earlier had highlighted "the importance of fundamental science," of "public engagement with science" and of "developing the research community." But by 2014, the governing arrangements had changed. The public research sector had come under the remit of the Ministry for Economic Development, with a commensurate change in the ministerial interpretation of the public purpose of science and research. Alluding to the need to prioritise carefully its limited research budget, while also bearing the burden of supporting private sector innovation, the business-oriented ministry had an overt "make or buy?" [63] attitude toward knowledge generation in the public interest, which was made evident in the consultation draft of the strategy.

The proposed strategy also stood in contrast to recent advice from the SAEI. In collaboration with New Zealand's CSA office, the SAEI had specifically undertaken to examine small countries' interpretation and expectations of the impact of their public "research investments". The SAEI report advocated for a much broader view of the impact than just economic productivity and commercialisable development. It suggested instead that small countries need to prioritise their national "value niches" and public-interest research that is "specific to their natural environment or population" (O'Connor & Harland, 2014).

As an international institution of peer support (and pressure) group, the SAEI-endorsed interpretation of impact was already attracting policy-maker attention in Finland

[63] (Doern & Stoney, 2009) refer to the neoliberal tendency to apply a 'make or buy?' test to public knowledge generation. Governments ask: do we need to generate this knowledge ourselves or can we find it on the market already?

and Ireland. In New Zealand, the influence of these transnational ideas would eventually partially permeate the final version of new national strategy (MBIE, 2015a). Interestingly, although the research community – and indeed the CSA - had advocated a similar perspective, it was not until the idea reached NZ from an international source that it appeared to catch government attention.

Another shared interest among SAEI members was the potential instrumentality of the public research sector to support regional economic development, as manufacturing was shuttering, and urbanisation was changing the demographic landscape in SAEI member countries (Key Informant Interview, Denmark SAEI participant). In New Zealand, the conservative government had addressed this issue in 2015 and 2016 budgets with the establishment of four fully Industry-Led 'Regional Research Institutes' with a $65M injection (MBIE, 2015b). However, these new system actors later proved to be minor players, except for the political capital their establishment may have generated for the government at the time.

By the time it was published, the new national strategy had rebalanced somewhat from the heavy focus on economic productivity which had characterised its consultation draft. Yet the government appeared to use other institutional levers to give effect to its interpretation of the purpose and value of the public research system, befitting its Business Growth Agenda. For instance, in 2015, it enacted to the Education Act to modify University governance arrangements. University Councils were shrunk, but a third of membership spots were maintained for ministerial appointees. At the same time, representation requirements were lifted, meaning that councils no longer had to include student, faculty or union representatives (TEC, 2015). The proportion of ministerial appointees and fewer constituent

representatives thus offered more opportunity for indirect ministerial steering of universities. It is noteworthy that the Danish government had made a similar change to encourage more industry-friendly conditions in Danish universities, which will be discussed in the following chapter.

At the same time, government sought to resolve the long simmering issue of CRI core funding, presumably to encourage less reliance on industrial contracts. The following year, it introduced a plan for the Strategic Investment Fund that was exclusive to CRIs, though still requiring a measure of competition (Goldsmith, 2017).

Politicisation of knowledge needs and gaps

The surprise resignation of Prime Minister John Key in December 2016 triggered a cabinet shuffle under Deputy Prime Minister Bill English. In an election year, the newly appointed minister for the science and research portfolio would inevitably have to address election issues where they intersected with the public research system. This put the question of public-interest research about the environment and freshwater onto the ministry's agenda in 2017 (Key informant interview, former ministry advisor). But the RSI governance regime was hardly structured to manage such policy interdependencies, with the bulk of research funding and policy capacity sitting within economic development ministry.

Having noted the structural problem, CSA had already been working with departmental science advisors since late 2016 to initiate an approach to the governance of public environmental science and research that would bring together conservation and environmental policy sectors within an overarching framework guided by Mātauranga Māori values and an ecosystem services approach rather than relying on the economic development ministry to lead work for which it was not equipped. The joint "Conservation and Environment

Science Roadmap," was launched in February 2017, laying out a proposal for how work in these areas should interact (MfE & DoC, 2017). The roadmap set a new institutional template for a more collaborative and strategic approach to prioritising, generating and applying knowledge in an area of obvious public interest – something the national science sector strategy had failed to address. And it was little wonder, given the responsibility for the bulk of the country's RSI budget had been placed within the remit of the economic development ministry, with no mechanism for addressing policy interdependencies. Indeed, "the Environment Research Roadmap provided a way to look beyond the ministry and the NSSI" (Key Informant Interview, MfE official).

The Roadmap was also timely because public consultation (and debate) over national freshwater management policy amendments was underway (MfE, 2017). The CSA established a technical committee of CRI and academic researchers to clarify terms and parse the 'national values' associated with freshwater, including its intrinsic cultural value, and multiple direct and indirect economic values (P. Gluckman, 2017). These were precisely the types of issues that typically divided opinions in New Zealand on the purpose and value of public research, and they found expression in the local edition of the worldwide March for Science that was about to take place. This timing put CSA's report under added public scrutiny.

The March for Science (www.marchforscience.org) was an idea external to the New Zealand RSI system. The movement began in the United States in the early days of the Trump Presidency and the height of climate change denialism. The purpose of holding a march in New Zealand was less obvious, yet it gained traction within the research community. Reasons ranged from solidarity with the beleaguered US public research community, to perceived issues with the New Zealand government's environmental record. Although the New Zealand

March for Science was promoted by the NZAS, the apparent confusion of its purpose kept away some individuals and institutions (Pickering, 2017). However, this debate surrounding the March further illustrated perceptions about the politicisation of the RSI sector– from the research community's scepticism about the proposed Code of Conduct for Researchers, to concern about the ability of CRI researchers to undertake and share research in the public interest.

Change in government: paradigm instability and renewal in public research governance

If ever proof were needed that public research systems are, by definition, an instrument of government to meet normative public policy objectives, and not simply a technical arena of policy making to support research, then a change in government provides a 'natural experiment.'[64]

The contestation of the November 2017 central government election resulted in an unlikely Labour-led coalition with the Green Party on one hand, and with the nationalist New Zealand First party on the other. As the coalition negotiations settled and policy-making began, the vision of the new Labour-led government's priorities came into view. Its underlying policy logic around "New Zealanders' well-being" contrasted markedly with the previous government's "Business Growth Agenda" for "NZ Inc."

[64] For instance, in both the US and Canada, election of progressive governments following more conservative regimes have brought issues of scientific research in the public interest to the forefront of public discourse. Obama's promise to 'restore science to its rightful place' following the Bush Whitehouse, was later mirrored in Justin Trudeau's promise to reverse Stephen Harper's apparent anti-science policies (Holdren, 2017; Quirion et al., 2016)

Aligning the RSI system to fit a new overarching policy paradigm required the construction of a new shared vision of the purpose and expected impact of public research, by building support in both deliberate and implicit ways. One of the earliest institutional changes was the Education Act Amendment to reinstating student and faculty representation on University governing boards (Education Amendment Act, 2018).

Another key step was to draft a new national strategy for RSI sector – the third one in seven years. The Labour-led government's thinking aligned with some of the work previously done by non-state advocacy groups like the SAEI in seeking to broaden the scope of impact beyond the focus on economic development and beyond monetised metrics of the social purpose of public research. In particular, the intrinsic values embedded in a Mātauranga Māori perspective needed also to be attended to meaningfully. To spark discussion and develop consensus, MBIE (now under a Labour minister within the coalition government) released the "Impact of Science" discussion paper for public consultation as a pre-cursor to the draft national strategy for the sector (MBIE, 2018).

The consultation paper distinguished the new government's thinking in a number of ways. First, it displayed understanding for the uncertainties and complexities of the research endeavour and the difficulties in assessing ex-ante impact[65]. Second, the concept of impact was now articulated around Treasury's Higher Livings Standards Framework[66] rather than the previous government's Business Growth Agenda (Treasury, n.d.). Curiously while the Living

[65] Whether this is due to new knowledge or expertise entering the public service or to a new appetite for knowledge (or both) is not known.

[66] The Higher Living Standards framework outlines 'four capitals' (Economic, Natural, Social and Human) and five domains in which the capitals must be considered (economic growth, sustainability for the future, increasing equity, social cohesion, and managing risks)

Standards Framework had been launched in 2011 by the Treasury under the previous right-leaning government, it saw little applied use until the change to a Labour-led coalition government in 2017. Treasury had logged only three documents that made use of the framework between 2011 and 2017, but there were twenty-six new papers that used it in a somewhat modified form between 2017 and 2020, including a monitoring 'dashboard' (Treasury, 2019). If the number of Treasury papers is a reliable metric, then the transition toward an underpinning policy logic of Wellbeing and Higher Living Standards and a de-emphasis of the Business Growth Agenda was underway, with the science and research sector enlisted to help.

By September 2019, building from the impact paper, a draft of the new Research, Science and Innovation Strategy was released for a three month public consultation (MBIE, 2019). Right from the outset, the inclusion of the word "research" in the strategy's title expressly set it apart from the previous "science and innovation investment" strategy of the previous government, giving apparent equal status to part of the system that is primarily associated with universities.

From there, the draft strategy echoed the Labour-led government's overarching public policy goals. Like the Labour government of the late 2010s in Denmark, New Zealand Labour was explicit about instrumentalising the RSI sector to "deliver these goals." The priorities themselves echoed international policy directions in the era of the Sustainable Development Goals. They included: transitioning to a zero-carbon economy; supporting regional development; protecting the environment; creating fulfilling and high-value jobs; and increasing wellbeing. However published feedback from the consultation suggested that government should be cautious about tying science and research too overtly to its own

political priorities (Royal Society, 2019). That risked instability in the associated structures and funding, should an incoming government overturn the priorities.[67] Yet, government directionality was nothing new; previous strategies had attempted to pick winners in ICT or creative industries, for instance. Perhaps the main difference with Labour's directionality in 2017 was the scale of change, which was unabashedly directed at governance of the whole RSI system rather than any specific policies or programmes within it.

In terms of specific priorities, Labour's draft RSI strategy was clear that government intended to concentrate effort in "a small number of areas where we can make the biggest difference," and "build scale in selected areas of opportunity, advantage and critical need" (Ministry of Business, Innovation and Employment 2019 p. 7). In listing these three criteria of ex-ante assessment, however, the strategy offered no clarity on how these normative decisions were to be made.

The draft strategy also committed to addressing the lack of systemic cohesion, acknowledging the fact that the institutions of New Zealand's research system had long incentivised – indeed required – a high level of competition which is now embedded in the culture and structures of the research community. The strategy therefore aimed to create the conditions to foster collaboration across the system. Its first target was a review of the CRI operating model "to ensure it supports dynamic, connected institutions and globally leading research" (Ministry of Business, Innovation and Employment 2019 p. 38). So significant was

[67] The New Zealand national electoral cycle is only three years, which accounts for much of the dynamism in policy-making. By contrast, knowledge production in public research might be measured in 3-5 year increments, the average time needed to show results from a PhD project or new funding cycle.

this issue, it seems, that a formal review of the CRI model was commissioned in October 2019, even before the draft RSI strategy had been finalised (MBIE, 2020). The review panel would be chaired by a former MBIE Chief Executive who was well positioned to understand the issues.

The draft strategy also broke new ground in its framing and use of Mātauranga Māori. Whereas previous discourse had emphasised developing capabilities and "unlocking potential" of Māori knowledge and resources, the draft RSI strategy re-orients the narrative toward prioritising the shared benefit that diversity brings to the generation of relevant knowledge, rather than focusing on Māori-held resources:

> Our RSI system is not yet fully capable in terms of engaging productively with Māori and our research system has significant gender disparities. This is bad for all of us. It is only by combining diverse ideas, background, knowledge, and experience that we will truly innovate at the global frontier, and have a research an innovation system that reflects the needs of our own society. (Ministry of Business, Innovation and Employment 2019 p.7)

As an analytical exercise, Table 8 shows the comparative use by the two governments of key terms associated with the science and research policy. While acknowledging that a keyword analysis is insufficient data from which to discern the full RSI policy logic, it nonetheless points to the lack of coherence that marks distinctive governance periods in RSI, creating instability in the sector. The keywords tested across consecutive strategy documents were chosen based on a combination of the recent literature, research system trends derived from OECD reports, and key informant interviews in New Zealand. The language of 'competition', 'innovation', 'growth' is associated most with the strategy of the previous right-leaning government, while words like 'collaboration', 'wellbeing', 'inclusion' are associated with Labour. It is noteworthy that the two concepts of 1) mobilising the research system to

support regional development and 2) engaging with Māori both feature nearly equally between the two governments' strategies. However, successive governments tended to emphasise different aspects of these concepts (e.g., from strictly development of Māori capability and economy to building a more inclusive RSI system through incorporation of the indigenous worldview).

Table 8: Comparison of key concepts in RSI strategies of National (right) and Labour (left) in New Zealand, 2015-2019

Key words from lit.	**Draft RSI (Labour 2019)**	**NSSI (National 2015)**	**Combined total**	**Labour%**	**National%**	
competitiveness	0	11	11	0	100.0	Terms used more frequently by National (right)
end-user	1	22	23	4.3	95.7	
investigator-led	2	24	26	7.7	92.3	
long-term	2	10	12	16.7	83.3	
productivity	11	40	51	21.6	78.4	
mission-led	3	10	13	23.1	76.9	
growth	19	54	73	26.0	74.0	
industry	25	59	84	29.8	70.2	
deliver	22	40	62	35.5	66.0	
skills	9	15	24	37.5	62.5	
Commerce/ial	14	21	35	40.0	60.0	
economic/economy	47	70	117	40.2	59.8	
small	19	27	46	41.3	58.7	
market	21	28	49	42.9	57.1	
collaboration	21	27	48	43.8	56.3	
product	35	37	72	48.6	51.4	Equal use of terms between right and left
competition (funding)	4	4	8	50.0	50.0	
regional/region	8	8	16	50.0	50.0	
Mātauranga	25	24	49	51.0	49.0	
priorities	21	16	37	56.8	43.2	Terms used more frequently by Labour (left)
Sustain/ability/able	28	12	40	70.0	30.0	
diversity	12	3	15	80.0	20.0	
inclusive	12	1	13	92.3	7.7	
competitive advantage	3	0	3	100	0	

Grey highlight = most frequently used terms overall

As it happened, the draft RSI strategy was never published in final form. The arrival of the Covid-19 pandemic on New Zealand shores pre-empted much of the government's policy-making agenda beyond the urgent public health response. However, as a statement of the government's policy rationale, priorities and planned organisational arrangements for the sector, the draft strategy certainly indicated a paradigmatic break from its predecessor.

6.6 (2020 -) Covid-19 Recovery, Defragmentation and Decolonisation of RSI

As societies and economies around the world paused in the grip of the COVID-19 global pandemic from early 2020, New Zealand emerged as an early proponent of stringent isolation measures to stop its spread (Allen et al., 2020). For the RSI system, the pandemic put on hold a number of processes that had been underway: consultation on the draft RSI strategy; a review of the PBRF system, a new selection round for the signature CoREs programme and of course the CRI review. Yet the pandemic did serve to draw public attention more generally to the social purpose of the public research system to support evidence-informed decision making. As a critical juncture, it called into question whether the organisational structures and underlying intent of the system were fit for purpose. For instance, the historic lack of a CRI or agency dedicated to public health research and monitoring was a lacuna made obvious by the pandemic. This is despite the admirably rapid shift of some CRI and university researchers toward virus forensics and modelling virus transmission (Te Pūnaha Matatini, n.d.).

Reforming organisational arrangements

In the pandemic context, and after three decades of a system fragmentated through market-driven competitiveness, the Labour government was keen to embrace collaboration rather than competition in the RSI sector and thus to re-design elements that posed structural barriers to it.

Perhaps in an effort to herald the government's move, the Forum of Departmental Science Advisors issued a discussion paper asking what a 'resilient' RSI sector should look like serve both knowledge generation but also to better respond to New Zealand's most pressing needs as it emerges and recovers from the pandemic (G. Evans et al., 2020). As practicing researchers who are temporarily seconded into government ministries, these advisors were in a unique position to not only advocate for the research community, but also to understand the considerations of policy makers. Significantly, they could point out the policy interdependencies that an RSI system, anchored in the ministry for economic development, had been unable to address sufficiently for decades. The discussion paper clearly called for government to renew their trust in the research community and to restore a level of material stability that would promote much needed collaboration, missing since the 1990s.

The CRI review, which was signalled in the Draft RSA strategy some eight months prior, was released in July 2020 (CRI Review Panel, 2020). With nearly one third of New Zealand's public RSI community working within one of the seven CRIs, the question of their future structure was high stakes. In the end, however, the review canvassed predictable territory. As a first volley, it did not explicitly call for structural reform, it nonetheless pointed to some key considerations such as possibilities for convergence of activities to reduce competition, and the need to release CRIs from the obligations of the Companies Act. Any serious uptake

of the review would have to wait, however, as pandemic imperatives and the governments broader agenda were pressing.

Implications of Post-Treaty Settlement Aotearoa-New Zealand on RSI paradigm

On that agenda – and despite the ongoing crisis – the passing of a new Public Services Act in August 2020 would set an important backdrop for planned governance changes across the public sector the following year (Public Service Act, 2020). A full analysis of the implications of this Act is beyond the scope of this thesis, but some key points provide important institutional context, beginning with the discursive return to 'Public Services' from 'State Services'. The passing of the Act signalled parliament's understanding of a new era of governance and policy-making, and a decline in the market-oriented thinking that had dominated for four decades. Analysts had pointed to the cumulative changes in policy-making that had begun to focus on public-interest and citizen-informed practices, but the Act also served as an important platform for restructuring government's relationship not just with citizens, but with Māori in particular (Te Kawa, 2020).

A slow-burning issue in New Zealand politics had been the coming of governance reforms in a "Post-Treaty Settlement Aotearoa-New Zealand" (Royal, 2021). The Public Services Act set the tone for putting into practice a more equitable relationship of collaboration with Māori to better acknowledge *mana ōrite* or equal authority between Māori and non-Māori authorities (Public Service Commission, 2020). Together with a commitment to a more "unified public service," which brought crown agents such as the Tertiary Education Commission under the Act, these changes set a new institutional context for the RSI system to better deal with policy interdependencies. The changes also addressed long-standing

issues of equity to better serve Māori, including epistemologically, by understanding and integrating the Māori worldview and principles into policy formulation. [68] The institutional imperative created by government's taking Te Tiriti o Waitangi seriously would eventually call into question the unexamined core of the RSI governance paradigm – that it was based on Western Scientific thought and practice, with little room for indigenous epistemology or ontology.

But perhaps the easier place to start enacting Treaty and Public Service Act imperatives was simply to create the structures and incentives to develop and retain Māori research talent. Both Māori-centred scholarship and Māori researchers across all disciplines was well-established through dedicated cultural tertiary level teaching institutes and in mainstream universities. However, the main driver to incentivise research outputs was the PBRF scheme, and this was a structural barrier to Māori scholarship because it was based on a mainstream system of recognition and promotion. Anyone who had experienced barriers to entry into the academic system or whose area of study did not meet conventional measures of output, would be unlikely to ever enjoy elite level success in the PBRF system. Recognising that Māori often fell into both categories, the Tertiary Education Commission changed in Performance Based assessment to give heavier weighting to Māori-centred scholarship and scholars (MoE, 2021). A seemingly easy fix, this was a significant change to the type of

[68] The Act required "Greater understanding of Te Ao Māori (worldview) woven into the work and ethos of public service, including: Te ao Māori concepts, knowledge, values and perspectives; Te Reo Māori (Māori language); Tikanga Māori (protocols and customs); Te Tiriti o Waitangi/the Treaty of Waitangi and understanding how it applies day-to-day." It also requires "the exercise of individual and collective responsibility for a culturally competent public service that delivers with and for Māori and is committed to supporting Māori leadership and decision-making roles in the Public Service."

scholarship recognised in the conventional PBRF system. Yet it did nothing to address the fundamental problem of rewarding only individual accomplishments rather than focusing on more collective research endeavours of university centres or faculties (Key Informant Interview, New Zealand Science Policy Expert).

The Prime Minister's Chief Science Advisor (Dame Juliet Gerrard from July 2018) had also brought in structural changes by introducing Māori expertise into the Science Advisors Forum. The two new Māori members of the forum would come to ask the deeper paradigmatic questions in a discussion paper on a 'Tiriti-Led Science-Policy Approach for Aotearoa New Zealand' (Kukutai et al., 2021). This paper laid out Māori principles and practices that could guide a more socially responsive, including and collective RSI system, while also addressing fundamental research questions in new and innovative ways. In this, the paper addressed the legacy of colonialism in the scientific enterprise.

The discussion paper landed just as the public discourse around the relationship between Western Science and Mātauranga Māori was heating up. In response to a new secondary school national science curriculum that introduced ideas about decolonising scientific practices, a group of senior elite University-based scientists published an open letter in a weekly news magazine (Dunlop, 2021). Entitled *In defence of Science*, their July 2021 letter met with accusations of racism and calls by some academics for a review of the authors' membership in the Royal Society of New Zealand. Many distinguished scholars and writers – both Māori and non- Māori – took pains to publicly analyse the implicit assumptions and evidence of privilege in the open letter (Ngata, 2021; NZAS, 2021; Waitoki, 2022).

The whole episode was emblematic of New Zealand's ongoing and difficult process to recentre public administration on Treaty of Waitangi principles and practices. In this process, RSI governance, despite a conventionally uncontroversial and low-salience public image, is set to have a starring role. Indeed, of the nearly one thousand public submissions on a 2021 Green Paper on RSI system reform (the follow-up to the CRI review process), it is the submission of a consortium of senior Māori researchers that stands out. Among the usual calls by researchers for increased and more stable funding, this consortium called for Tiriti-based RSI governance reform and a Tiriti-informed process:

> A Tiriti-based RSI reform will affect all parts of the RSI system, and the MBIE consultation process was an ideal opportunity to start exploring what that means with a wide national audience - what barriers must be overcome, and what information the RSI sector needs to understand to participate in reforms that embeds Te Tiriti. Instead, Te Tiriti was primarily siloed to a singular discussion, and often at the end of break-out sessions with insufficient time allowed for meaningful discussion. Those consultations could have yielded valuable insights on tauiwi perspectives of what is needed to bring the RSI sector into a Tiriti-based approach. It will be imperative that there are more Tiriti allies in existing institutions — universities and CRIs— if true power and resource sharing are to be achieved with robust links between the national institutions and proposed regional hubs. This will help ensure that mātauranga is acknowledged and embraced but not usurped. It will also help relieve the Māori RSI workforce of our cultural double shift. The Crown has a responsibility to fill this critical knowledge and practice gap amongst tangata Tiriti. (Te Pūtahitanga Collective 2022, p. 8).

As a small country, with little budgetary buffer, New Zealand's public RSI system has always been marshalled into service in a highly directed and transactional way by government. Yet there have been abiding tensions in the system, which has struggled to articulate a common and galvanising vision, made evident by some of the published responses to the MBIE Green paper consultation. While such tensions stem in part from differing views on the social purpose of public research, they are amplified by the legacy of neoliberal

institutional reforms of decades ago. This has led to the long-held policy expectation of transactional research with predictable, short-term outcomes, often in dominant economic areas, which has cast a long shadow in shaping the entire RSI system.

The foregoing chronology has identified and detailed the fluctuating periods that characterised the New Zealand RSI governance regime and shone a light on ongoing struggles with paradigmatic instability. The chronology has shown how RSI's governing arrangements have been shaped paradigmatically, but also how they have been destabilised in response to a combination of factors at multiple scales, hinting at the emergence of a new (3rd) dominant paradigm. The next chapter now takes this same analytical treatment to the chronology of Denmark's public research sector.

Chapter 7 Chronology of Paradigm Construction in Denmark: A European story

It's not linear. Certainly, Denmark has had an influence in Europe in terms of supporting less bureaucracy, more flexible funding frameworks, better cooperation between public and private institutions, and better cooperation within Europe. At the same time, since 2000, Europe has influenced the direction of science in member states, including us.

Key Informant Interview, former member Danish Council for Research Policy

This observation by a Danish research policy expert encapsulates the essence of Denmark's public research governance regime. In marked contrast to the relative isolation and independence of New Zealand's public research system, the Danish system, described in Chapter 5, has clearly co-evolved with events in broader European context throughout the 20th Century. Therefore, just as in New Zealand, Denmark's research system must be understood in historical perspective and in the context of European and Danish institutions and identity. Table 9 previews the distinctive periods in the Danish research governance regime, demonstrating where the dominant sectoral paradigms show in/stability and potential for an emerging 3rd governance "generation" (paradigm). The detailed analysis follows.

Table 9: Distinctive periods in research governance paradigms in Denmark, discerned by paradigmatic features

RSI Paradigm (theorised in the Lit)	Distinctive period	Rationale (Perceived social value of public investment in research sector)	Policy objectives and thematic priorities	Operational arrangements	Actors / roles
1st Generation governance paradigm (Scientific Freedom)	**Early 20th Century and war years** *Foundations and Philanthropy*	- Research support for/by industry but Universities' research intensity begins	- De facto physical science (Niels Bohr) - Refuge for exiled scientists	- New university departments emerging - Philanthropy dominates funding system	- Industry foundations (big 4) - Outspoken elite scientists (e.g. Niels Bohr) - Little gov't steering
	1950-1984 *Paradigmatic paradox: Scientific Freedom/ Science for Sovereignty*	- Prevent brain-drain to USA - Establish scientific reputation in EU - Protecting Danish Sovereignty in the Arctic	- Physical sciences (beginning of CERN, ionosphere research) - Quintessential of the nuclear age	- Early steering of yearly appropriations to universities - Joint Research Council system to help steer (academic-led)	- Foundations - Joint Research Cn International and multilateral: - Euro collab CERN - US Dept of Defence - OECD guidance
2nd Generation Governance paradigm (government -led, competitiveness-focused)	**1985-2000** *Management & accountability focus*	- Steer and incentivise universities towards harnessing economic potential	- Management and accountability of publicly funded researchers	- Intro university performance contracts - New public foundation to appease resistant academics, but avoid perceived 'capture'	- alternating gov'ts - DNRF established outside Research Council academic system (1991) - Inaugural Ministry of Research (1993)
	2001-2010 *Int'lisation & competitiveness focus (co-evolution of Denmark's and Europe's RSI gov. regimes*	- Internationalisation of research sector (threat of China and seeking influence in Europe) - Innovation for competitiveness (aligned with European position)	- "From insight to invoice" - Globalisation Strategy: *Denmark in the Global Economy: Progress, Innovation and Cohesion* - Industry-University collaboration	- Close universities (12 to 8) - Major structural reforms to merge public research orgs (PROs) into universities	- Name change: Min. Science, Technology and Development - PM's Research Commission (on Struct. Reforms) - Globalisation Council Int'l and multilateral: - ERA, ERC launched
Emerging 3rd Generation governance paradigm (co-design, collective challenges, global perspective)	**2012-2014** *Smart specialisation (prioritisation) focus*	- Linking industrial and higher education policy - Government steering for industry-led 'solutions' (inspiration rather than incentives or regulation)	1st national strategy: *A Nation of Solutions:* - Innovation driven by societal challenges (e.g., green tech) - Higher education should help increase industrial capacity	- System-wide cross-party prioritisation exercise - Launch of Innovation Fund Denmark - Launch of Danish Council for Research and Innovation Policy	- Name change: Min. Science and Higher Education - Innovation Fund takes the innov. portfolio outside of government - R&I policy advice is outsourced
	2015-2019 *Innovation and efficiency focus*	- Budget cuts (first time in history) - Completing structural reforms project	2nd national strategy: *Ready to Seize Opportunities* - Settling funding formula - linking industry and higher education	- Brining the innovation and advisory portfolios back under the Ministry proper	- Rebuild government's industrial liaison capacity
	2020 and beyond *Recovery and Transitions focus*	- RSI in economic, health and social sector recovery from Covid - Denmark's voice in Horizon Europe Framework	Main policy arena (other than Covid) is at European Level to finalise new FP: - Supporting the Green New Deal for Europe - Societal 'Transitions'	Multi-level alignment of national systems is set as condition of Euro funding (collaboration, shared purpose, societal transitions).	- European Commission, DG Research - Danish negotiators - … to be continued…

7.1 Early 20th Century: Foundations and Philanthropy

Unlike the settler science regime of early New Zealand, Denmark's begins from strong academic science foundations. The establishment of Denmark's first faculty of science in 1850 within the oldest university (University of Copenhagen, est. 1479) came a year after the country traded monarchy for constitutional democracy. It is tempting to think that this timing may be an indication of the interrelationship of modern science with democracy through a publicly funded science sector. Yet despite comparatively 'thick' institutions of Denmark's well-established academic sector (Campbell & Pedersen, 2015), the early support and governance of research in Denmark came mostly from private philanthropy rather than public coffers.

In 1914 Carlsberg brewery heir Carl Jacobsen bequeathed his mansion, through his company's charitable foundation, for "use by the Dane who made the most prominent contribution to science." (Carlsbergfondet, n.d.). It was most famously occupied by Niels Bohr. Bohr had founded the Institute for Theoretical Physics with the help of American private philanthropy (Rockefeller) at the University of Copenhagen in 1921, one year before being awarded the Nobel Prize for physics. As a scientist and research policy pioneer, Bohr helped establish the deep internationalist, industrialist and philanthropic roots that still characterise the Danish research governance regime today.

In 1933 Bohr secured philanthropic funding to help academics threatened by Nazism in Germany. This support provided for refuge and employment, much to Denmark's benefit,

even after its 1940 occupation by Nazi Germany (Carlsbergfondet, n.d.).[69] Decades later, private philanthropic foundations are still a cornerstone of the Danish public research system.

7.2 (1950 – 1984) Cold War Paradigmatic Paradox

Post-war dynamics in Europe created unique conditions for Denmark, which in turn left it in a paradoxical situation. On one hand, Denmark's reputation as a champion of the Scientific Freedom paradigm promised to attract, develop and retain national scientific capacity in the face of brain-drain to the triumphant US (Knudsen, 2019). On the other hand, post-war conditions thrust Denmark into actively instrumentalising its science in the service of Danish national interests in Europe, and Danish sovereignty in its off-shore territorial interest, Greenland (Heymann et al., 2011; K. H. Nielsen, 2016). While these underlying science policy logics might seem contradictory, both were legitimate responses to Cold War geopolitical conditions.

One important science policy arena for Denmark's aspiring position within Europe was the CERN nuclear physics laboratory.[70] CERN's development had been prompted by Western European leaders who recognised that serious investment and coordination would be required for a European science and innovation ecosystem that could compete with the US (CERN, n.d.). This concern provided momentum for twelve European nations[71] to establish

[69] Details of Denmark's occupation by Germany during the 2nd World War are beyond the scope of this thesis, but is worth mentioning because of the impact, on Denmark's scientific enterprise, of refugee scientists as well as Bohr's own diplomatic activities on behalf of Jewish scientists. By 1943, Bohr would escape to Sweden from where he was summoned to the UK and then to the US to work on the famous war-time Manhattan project.

[70] Conseil Européene pour la Recherche Nucléaire' is the joint European nuclear research laboratory, which now houses the world's largest particle accelerator. It is also widely known for its foundational data-sharing network that became a precursor to the modern Internet.

[71] These were: Belgium, Denmark, France, Germany (Federal Republic), Greece, Italy, The Netherlands, Norway, Sweden, Switzerland, UK, and (then) Yugoslavia.

the lab, with Denmark's (and Bohr's personal) support playing a pivotal role.[72] Thus through its involvement in CERN, Denmark could champion fundamental physical science while at the same time mobilising that position to exert its national interests by establishing itself as an actor of significance in the larger European integrationist project. As a small country, Denmark thus set itself up with a disproportionately large voice within the early institutional foundations of European research decades later. This voice would later exert considerable influence in establishing the European Research Area and Framework funding schemes of the European Commission.

Embedding Scientific Freedom on home soil

Closer to home, the paradigmatic paradox was also manifest. On one hand Denmark was actively building a scientist-led research system through public and private investment and new governing arrangements. It started in earnest in 1954, with the establishment of the first Faculty of Science outside of Copenhagen, at Aarhus University. This was followed by foundational governance infrastructure in the early 1960s. Indeed, just as the OECD was conceiving its influential ideas and methodologies for the governance of what it call national research and development systems (Henriques and Larédo 2013b, see also section 2.2 this thesis), the Danish government established the scientist-led Joint Research Council. The aim of this council was to advise government on investment from the perspective of the scientific community, thus maintaining coherence with the Scientific Freedom paradigm.

[72] In 1957, Denmark hosted scientists of the 'CERN group' who were drawing up plans for is development and scientific program and playing an important role in the most significant transnational science project in Europe, one that would set the bar for science diplomacy and collaboration that would be built on in the decades to come.

By 1968 this paradigm had really gained momentum, as a system of five discipline-based independent research councils was added to mediate between government and universities. Even if the government established the research councils in a bid to steer the growing system, they were nonetheless conceived as a scientist-led, and thus perpetuated the dominant paradigm. This policy position may have been more by default than by design, however. Indeed, the government's relative lack of influence equally could be explained materially by its inability to invest very much in research, when compared to private philanthropy (Carlsbergfondet, n.d.).

Scientific Freedom at home, instrumentalisation abroad

Where the government did exert remarkable science governance influence, on the other hand, was in Greenland. After the Second World War, the United States' strategic interest in Greenland forced Denmark into the geopolitical spotlight. This prompted a show of Danish sovereignty for which science governance provided the ideal framework (Heymann & Martin-Nielsen, 2013). As a result, the 1951 US-Danish Defence Agreement on Greenland required that the US seek Danish permission for research activities outside of three clearly delineated 'Defence Areas' (American military bases). This agreement therefore curtailed American activities on the ice cap, which it considered potential terrain for rocket testing (Knudsen, 2019). At the same time, Denmark continued strategically to develop its own research interests in Greenland, focusing on geological surveying and the fundamental science of the ionosphere (Taagholt, 1972). One can speculate that, if not for the fact that Greenland provided the ideal location for such work, ionospheric research might otherwise have seemed a surprising priority for the Danish government.

During this time, the Danish government also displayed a paternalistic concern for the indigenous Inuit Greenlanders, which was a prevailing colonial idea that was typical of the era. From 1953 until Greenland's Home-Rule in 1979, Denmark set about establishing its welfare state model in Greenland, including the amalgamation of settlements, establishment of public services and managed industrial sectors (Andersen, 2020). There were also attempts at more overt cultural assimilation such as the now infamous Fedgaarten experiment.[73] The perceived spectre of American cultural influence was additional motivation for the Danish government to relocate settlements it deemed susceptible to fraternisation with the Americans (Heymann et al., 2011).

In 2014, five years after the establishment of Self-Rule, the Greenland government embarked on a Truth and Reconciliation process aimed at "'decolonising' the minds of Greenlanders" but not necessarily to seek any specific government accountability. For Denmark, the merits of the process, which did not involve the government of Denmark, have been debated in Greenland (Andersen, 2020). However, it did draw the Danish public's attention to the negative impact of their government's efforts. In December 2020, the Danish PM Mette Frederiksen made an official apology to the surviving Fedgaarten children and their families and as such began to draft a conclusion to the Danish colonial chapter that had seen the mobilisation of science governance to assert sovereignty and to underpin cultural assimilation (Frederiksen, 2020).

[73] This social experiment from 1951 to 1952 separated 22 Inuit children from their families to be enculturated as 'Little Danes' at a holiday camp in Denmark. The trauma of the experiment is detailed in the 2017 (Brend & Meuse, 2022)

Thus, in contrast to New Zealand at the time, the Cold War years were a period of intensive evolution in science governance for Denmark by virtue of its geopolitical context and the particular way that ideational, institutional and material factors were interpreted in this Cold War context. For instance, in the multi-level institutional context of the European Union, Denmark was able to establish a reputation as a champion and supporter of European research within the Scientific Freedom paradigm. Yet at the same time, in the colonial context of Greenland, the Danish government was more directional in its public research governance approach, which it deployed as an instrument to assert sovereignty.

The paradox of these differing policy logics is reconciled if they are both seen as part of an overarching governance paradigm which saw Denmark mobilise science and research governance for strategic positioning and broader policy goals rather than for economic development purposes only. In this way, the Scientific Freedom paradigm not only survived, but appeared to be actively supported by government, which saw the political (as distinct from economic) utility of a healthy and active research sector.

7.3 (1985 – 2000) Management and Accountability

It was not until the 1982 election of the first right-leaning government in Denmark since 1901 that any discernible direction-setting by government in the RSI sector (beyond the Greenland colonial context) would occur and the central Scientific Freedom paradigm of the research regime began to destabilise (Aagaard, 2017; Carlsbergfondet, n.d.). The government was keen to see more explicit cooperation between universities and industry, with a view to national economic transformation. The notably 'applied research' fields of Biotech, IT and materials

engineering were identified by the government of the day as sectors for investment. The year 1985 marked a turning point as major industry-facing public research funding was made available, including a world-leading industrial PhD scheme. This programme supported graduate students to conduct their thesis research within industrial settings, along with "every now and then, a little bit of money to fund some in the public sector as well, but it was very rare and not very much money" (Key Informant Interview, Science Policy Expert).

By the end of the decade the conservative government's obvious shift toward innovation and industrial research funding for economic development was prompting a response from the academic establishment. The concern was not only about funding but also the potential influence in policy and decision making. Indeed, government's attempt to reform the largely academic Research Council system was met with considerable resistance and counter-mobilisation (Aagaard, 2017).

Destabilisation, academic resistance and paradigmatic struggle

The 1991 decision to launch the Danish National Research Foundation (DNRF) appeared, in part, to be a response to this academic unrest. Just as New Zealand's Marsden programme was seen as a "safety valve" and concession to Scientific Freedom, Denmark's DNRF's flagship programs catered to classical university needs. These programs promoted Investigator and Post-graduate funding and a new Centres of Excellence program to help reduce fragmentation and provide stability to the Danish research landscape. Danish science policy scholar Kaare Aagaard has suggested that the advent of the DNRF, as a new and significant regime actor, ushered in an academic reorientation of the system after a decade dominated by strategic and industry-facing research (Aagaard, 2017). However, he notes that government deliberately placed this new actor outside of the existing Research Council

institutional context. This, Aagaard suggests, was perceived by government to be "captured" by University interests (Aagaard et al., 2016). Yet, others have perceived the period as "returning the power to the universities" (Key Informant Interview, former member of Committee on R&I policy). In either perspective, it was perceived as a rebalancing trend that would continue throughout the 1990s under the Social Democratic government, which was elected in 1993.

Social Democrats re-interpret key regime actors

Such rebalancing did not reinforce any Scientific Freedom paradigm, however. Instead, the incoming Social Democrats took key steps to reposition research regime actors in a new institutional landscape. Universities were reinforced, but their role was re-interpreted as instrumental actors to more explicitly help achieve broader public policy goals (Degn & Sørensen, 2015; European Commission, 2020a).

Indeed, the introduction of a new system to provide for universities' indirect research costs (overheads) was evidence that the university governance changes did not amount to government's endorsement of their full autonomy. Certainly, providing for indirect costs would reduce the pressure on universities' core operating funding. Yet, with this financial relief came a new mechanism to govern access to the new funding and to monitor universities' compliance with funding terms and conditions set by government. This combination of reforms introduced a more active role for government within the University system, while devolving management responsibility to university administrators. It was entirely in keeping with New Public Management approaches of the emerging neoliberal era (and not dissimilar to concurrent changes happening in New Zealand). To this end, the first

Ministry of Research was established in 1993 to oversee the growing policy complexity of the public research landscape and to steer the increasing instrumentality of universities.

By the end of the millennium, Danish academics had resisted government's second attempt to reform (indeed abolish) the largely academic-driven Research Council. However, the government did manage to introduce a system of performance contracts for universities. It was an ongoing struggle over the governing paradigm and the degree of instrumentalisation that the academics would bear (Degn and Sørensen 2015; Key Informant Interview, Former member R&I policy council). Yet this was only the beginning of the structural changes to come in Denmark's research governance regime.

7.4 (2001 – 2010) Internationalisation, Competitiveness & Co-Evolution with Europe

As the 21st Century dawned, Denmark's research governance regime became more overtly entangled with supranational developments within the European Union's broad integrationist project. This time, the Danish research community's involvement in Europe was more systemic and institutionalised than had been the Bohr-led actions during the war. The Danish state's establishment of university performance contracts in 1999 was in keeping with the EU's supranational interpretation (and promulgation) of the idea that Universities in member states should be major actors in their 'innovation systems,' alongside public research organisations which traditionally occupied this innovation-focused role (Lepori et al., 2007; Nedeva, 2013). Any indication of public interest research (i.e., Research strictly for public policy relevance rather than for commercialisation) seemed to be either taken for granted, or the need for it was overlooked.

Construction and Institutionalisation of a European vision for public research

The EU's Lisbon Strategy of 2000, recast public universities across Europe in a new frame. They were now viewed as instrumental to the 'European project' with the dual goals of social cohesion, within and across national borders, and collective economic competitiveness on the world stage (Gunn & Mintrom, 2016). The Lisbon Strategy established a collective interpretation through its stated goal "…to become the most competitive and dynamic knowledge based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" (European Council, 2000).

Within the context of this overarching policy rationale for Europe, the launch of the European Research Area in 2000 was intended to address what the EU government perceived as a fragmented "European research and innovation system" which "consisted of the juxtaposition of the national R&I system and an EU level funding program" (European Commission, 2020b). In other words, the expressed need for an ERA can be interpreted as the EU's assertion that member states' science and research regimes should be better aligned to Europe's supra-national goals (i.e., researcher mobility and efficiency of research performing organisations.

Thus, the multi-level tension that has long been central in research and science policy (i.e., that researchers are expected to respond to both national interests and international scientific aims), acquired an added layer of complexity in the European institutional context. National research systems of member countries were re-framed as principal instruments of the broader European integrationist project, in accordance with the Lisbon strategy, and through the mechanism of the ERA.

As a small country, Denmark relied heavily on EU funding for public research. This meant that the multi-level dynamics in its research governance regime were unavoidable (Sander 2002; Key Informant Interview; Ministry official). At the same time, as a vocal member of the EU, Denmark would nonetheless wield its influence to shape ERA implementation and create favourable conditions for small research systems within an institutional structure often dominated by Germany, France and (at the time) the UK.

Destabilisation: reframing and renaming the key institutional actor

The Danish national election in 2001 installed Prime Minister Anders Rasmussen of Venstre, a right-leaning party, who brought more market-oriented ideas to his government. The decade that followed would see a series of deep and sweeping structural reforms to the governance, organisational arrangements, and material conditions of the Danish research regime. Reforms began with the reframing (and renaming) of the central regime actor. Thus, Denmark's ground-breaking Ministry of Research (1993) now became known as the Ministry of Science, Technology and Development (2001)[74]. The name change seemed to discursively signal government's intentions for the sector.

As was the case with New Zealand's first right-leaning government of the 21st century, Denmark's Venstre would be highly interventionist in research governance regime. They moved quickly to establish a Research Commission, which proposed continued reforms through wide-scale rationalisation. These included: reducing the number of Universities;

[74] 1993's Ministry of Research had already undergone one name change to the Ministry of IT and Science in 2000. The incoming conservative government moved relatively quickly to rename it, dropping 'IT', and adding a more generic 'Technology' along with 'Development'. The loss of 'Research' and the addition of 'Development' may be interpreted as a discursive move toward supporting more applied rather than fundamental research.

integrating the many PROs (similar to New Zealand's Crown Research Institutes) into the academic sector; and ensuring greater collaboration between the remaining Universities and industry (Aagaard et al., 2016). In keeping with Venstre's larger agenda, Rasmussen sought to move Danish institutions away from their roots in a welfare-state policy paradigm and towards a competition-state paradigm (Degn & Sørensen, 2015). In keeping with its market-oriented focus, the Venstre government began more explicitly to seek greater certainty of return on investment in science and research, despite the inherent uncertainty of this type of work. As one member of the former Research Policy Council put it:

> Part of what the Prime Minister was doing, was to create this 'science technology and innovation' government. And he put one of his trusted political – well – friends in charge of this. He didn't know very much about research, but everyone remembers him for this slogan "From thought [insight] to invoice." And so along with this heavy investment came this whole idea that universities had to be much better at transforming knowledge into business. The foundation for that was made in the 90s, but after the turn of the century that's when it was really big. (Key Informant Interview, Danish Science policy expert)

Exploiting multi-level institutional contexts: With national reforms, EU fills the gap

While these reforms were taking hold domestically, Denmark's international role and standing within Europe created opportunities to shape the funding conditions for national research communities within the multi-level EU system. In a strategic grassroots move, during Denmark's rotation to the Presidency of the European Council in 2002, the embattled academically-dominated Danish Research Council organised and hosted a conference, the main aim of which was to explore the need for a European Research Council to protect and fund "fundamental science" (i.e. science-led, rather than government-directed projects) within the institutional framework of the ERA (Gunn & Mintrom, 2016; Nedeva, 2013). With

the support of Denmark's minister for Science Technology and Development, a Danish-led expert committee was established to study this institutional proposal. However, the committee's 2003 recommendation for a European-wide funding council for fundamental research received only lukewarm support from the European Commission at the time.

The Commission still seemed to consider its role as a funder to be limited to enabling collaboration and mobility across borders, thus leaving specific research agendas to be set and funded by member states. Yet, since the advent of the Lisbon strategy, European governance discourse nonetheless positioned member state research systems as key for the breakthrough knowledge and innovation that *Europe* needed. Denmark thus pointed out the contrasting goals and called for more European support to member-state research.

A coalition of support from elite scientists (including Nobel laureates and heads of research organisations) unsuccessfully lobbied the European Commissioner for Research. It was not until 2004 and the arrival of a new Director General serving the Commissioner, that the ERC idea gained traction at the European level. The new Director General strategically reframed the role and perceived value that the supra-national government would have for member state research systems. He argued that, in addition to encouraging and enabling collaboration and mobility, Europe should also "fund excellence" by catalysing continental competition in high quality, undirected, science-led research (Nedeva, 2013). The emphasis on competition met the market-oriented paradigmatic expectations of the era, while researchers gained a funding channel that did not constrain them strictly to national-interest research agendas. Thus, the ERC was launched in 2007. Europe's reoriented investment strategy was arguably initiated by Denmark in in the context of its own national reforms which had been perceived by its research community to be constraining fundamental research. Yet,

the introduction of new European funding would now justify even more supra-national influence on national research governance dynamics and thus greater multi-level expectations for the research community to satisfy.

The Right-leaning government institutionalises its own interpretation of the purpose of public research: 'From Insight to Invoice'

Against the backdrop of these supra-national developments, Rasmussen's Venstre turned its attention to the institutional changes it had set in motion for Danish Universities. Under the banner of its now (in)famous strategy, "From Insight to Invoice," Venstre actively sought to leverage University governing boards to set the direction of universities, which the government interpreted as underutilised potential for business (Shore, 2020).

In a 2003 reform of the Education Act, the composition of university governing boards was changed to require a majority external members, particularly from the business community. The 2003 Act was an institutional revision that would set the conditions for sweeping organisational mergers and change the shape of Denmark's research system, by giving actors outside academia (i.e. government and industry) more reach into university governance in the years to follow:

> There was a huge effort, at least in Denmark, to make more university industry collaborations, new incentives, a lot of focus on patents and on merging those two together. That had backlash though. It was really not well perceived by the academic community. They really felt that they were being delivered to the hands of the industry. […] The media coverage was saying now we are buying science, it is too ingrained with business interests. The minister of industry had this motto: 'from science [insight] to invoice'. And at the same time, you had the excellence agenda coming in where you said, more long term, more trust, more blue sky. But the two are in complete tension. (Key Informant Interview, Danish Science policy expert).

Additionally, the government's establishment of distinct *Strategic* and *Independent* Research Councils further steered toward university-industry collaborations. For the second time, a right-leaning government chose to place its new governance organisations outside of the longstanding academic Research Council System. Instead, it layered another institutional actor onto the system, thereby circumventing those that had shown themselves to be historically unsupportive of the government's approach.

New Zealand academics saw similar governance changes when that country's right-leaning government shifted toward a Economic Competitiveness and Innovation governance paradigm. [75] Unlike their Danish counterparts however, New Zealand academics did not have the same access to European funding for fundamental research (i.e. scientist-led and undirected), which arguably provided Denmark a counterbalance to the strategic changes unfolding at the national level in accordance with the government's economic framing social purpose of public research.

International experience seeds ideas about rationalisation and globalisation

Without exception, when asked about this period in the history of Danish research governance, all interview respondents pointed to Prime Minister Anders Rasmussen's trip to China in 2004 as a critical juncture after which his government redoubled efforts to reform

[75] By way of comparison, the right leaning National-led government in New Zealand at the time had also identified University governing boards as a site of reform to institutionalise a more business-oriented paradigm within higher education policy, while shifting the relative proportion board members away from faculty and student membership in 2015. However, this move to open and redirect board structure was overturned in 2017 by the incoming Labour-led government.

Higher Education and Public Research Organisations, and to instil a culture of global competitiveness through innovation:

> So, the narrative changed. What happened is we had a change of government in 2001 and went from long term social democratic rule to neoliberal thinking and then the new Prime Minister went to China and got spooked and came back and made this globalisation council which is kind of high-status ministers and a few other people. What came out of that was, by selling some state property they made kind of a lot of money that was then put into a [globalisation initiative], which was to change the whole knowledge structure of society and to say 'ok now we need to invest massively in science and technology' and some people said 'in education too', to boost Denmark into the next century or millennium. (Key Informant Interview, Danish Science Policy Expert)

The China visit clearly convinced Rasmussen that Denmark needed a globalisation strategy to be competitive and to take advantage of growing potential global markets for Danish education, research and innovation, especially now that universities were meant to be more accessible to industry (Rasmussen, 2008). Rasmussen would no doubt also have been aware of Denmark's homegrown academic expertise in science and innovation policy, which had been developing the distinctive Danish model that balanced economic competitiveness with 'social cohesion' prioritise (B. Lundvall, 2007; B.-Å. Lundvall, 2002).

It was with this combination of motivation and ideas that Rasmussen led, over the next four years (until his departure from politics to lead NATO in 2009), unprecedented structural changes to the Danish research system. These changes positioned the systems as the central pillar – and indeed a product – of Denmark's newly minted globalisation strategy, as well as placing it within the broader European discourse of global leadership in innovation.

The new strategy, entitled *Denmark in the Global Economy: Progress, Innovation and Cohesion,* was launched by the Danish Globalisation Council in 2006 (Royal Danish Min. Foreign Affairs, 2006). Rasmussen had established and personally chaired the council in the

year following his China trip. The strategy set out three high-level goals for the Danish research regime, which complemented the reforms and directional shifts already underway in Higher Education. These goals were: to increase the overall expenditure on research and development (GERD) to 3% of GDP[76]; to double the number of PhD students; and to enable more rapid dissemination of public sector research results for use by the private sector (Wohlert & Klöcker-Gatzwiller, 2016).

Preconditioning the 'competitiveness' focus with major structural reforms

There was little doubt that the Venstre-led government placed high value on the public research and higher education sector insofar as it served the now-dominant policy paradigm of competitiveness-focused RSI. But while this focus was similar to New Zealand's, Denmark's institutional context as an EU member meant that ideas developed and were operationalised quite differently.

Both countries' research governance regimes maintained a belief in the importance of competition in operationalising the purpose of public research. However New Zealand's ideological commitment to neoliberal governance strategies, together with the material constraint of small size and relative isolation influenced how idea of competition was interpreted and given effect. It was competition between Universities and public research

[76] Within the 3%, publicly financed expenditure should reach 1% of GDP. There was a related aim to allocate half of this public expenditure to open competitive funding, with an emphasis on larger, longer-term, strategic research projects. At the same time, government expenditure also had been going to overseas Danish Innovation Centres, a program to promote Danish international collaboration in knowledge industries, which was expanded under the new Globalisation Strategy. The first Innovation Centre was launched in Silicon Valley in 2003, followed by centres in Shanghai Munich, New Delhi, Seoul. Centres in Boston, Tel Aviv were launched in 2016. In 2018 Venstre announced more centres but lost the following election.

organisations that ultimately led to a legacy of fragmentation and an over-reliance on transactional research as an income stream (MBIE, 2021).

Denmark, by contrast, was able to develop a cohesive *Danish* competitiveness within the larger European context. Echoing the country's underpinning commitment to social cohesion and solidarity, Danish researchers would be structurally encouraged to collaborate. The locus of competition shifted to the prestigious new funding within the framework of the European Research Area, which Denmark's own research and policy communities had helped to establish. Thus, far from fragmenting its domestic system, Denmark would embark on a campaign to do the opposite. It amalgamated and streamlined research funding schemes and merged universities with PROs in an apparent bid to achieve a more cohesive and efficient system, albeit still aimed at innovation and economic development. When the process was complete in 2007, eight of twelve universities remained. Twelve of fifteen PROs were merged into the remaining universities (Aagaard et al., 2016). [77] These mergers were the culmination of a process that had been pre-conditioned by major institutional reforms in Danish university governance over the previous four years. At the same time, they responded to parallel policy developments at the supra-national level.

The multi-level institutional influence of Europe: Reshaping member states' RSI systems through the ERA

[77] According to Danish research policy scholar Kaari Aagaard, the ministry of science lacked horizontal influence on sectoral ministries that financed three of the PROs which chose not to merge.

The European Research Area (ERA) was now gaining momentum, and in 2007 it issued a Green Paper laying out six new goals it sought to encourage among member states. Most significant among these was to introduce the notion of 'grand societal challenges' to be addressed by the public research communities of member states (Macq et al., 2020). Thus, Danish national reforms could be made sense of (or conveniently justified to an unhappy academic community), at least in part, as operationalising ERA goals.[78] Indeed, perhaps to appeal to the inherently internationalist Danish research community which was about to face significant domestic pressures, the government framed the merger process as key to the country's "international impact through EU funding" by better enabling Danish researchers to work together, competing against "the best in Europe" (Aagaard et al., 2016).

The ERA Green Paper also defined three principles aimed at harnessing member research power to help meet pan-European goals. Europe would provide research funding for projects that were "deeply rooted in European Society; strike the right balance between competition and cooperation [between countries]; and derive benefit from Europe's diversity" (European Commission, 2007).

Structural constraints and the multi-level institutional context exert pressure to align with European perspectives

Accepting European funding therefore meant accepting increased convergence across Europe of how the purpose of public research should be interpreted and operationalised

[78] The 2007 ERA goals were: 1) An adequate flow of competent researchers; 2) World-class research infrastructures, integrated, networked and accessible; 3) Excellent research institutions; 4) Effective knowledge sharing; 5) Well-coordinated research programmes and priorities; 6) A wide opening of the European Research Area to the world.

nationally (Barre et al., 2013; Cagnin et al., 2012; Nedeva, 2013). Within FP7, the converging trans-national paradigm was European Competitiveness through funding research for both "scientific excellence" and "major needs in society". As one well-placed Danish science policy maker described this supra-national influence:

> […] How can we afford as a nation not to follow the trends? But is it useful to talk about global challenges in areas where we are not strong? Do we make our policies to get funding from the Framework Program or because we want to solve societal challenges? The trend is that money rules. So, there is convergence, but of course it is not black and white, it's very muddy […] But can we say our system is really getting any better when we do exactly the same as everybody else? […] Within the Framework Program, the government is focused on maximising how much money can flow to Danish scientists, but of course it's not just about the money, it should be a means to achieving something for Danish society. So where do you put your targets? What are your driving indicators for domestic science policy? (Key Informant Interview, Danish Science Policy Council).

Thus, structural constraints in the multi-level institutional context (Supra-national governance and national reforms) and the material context ("maximising how much money can flow") played a role in how both the Danish Government and the research community came to interpret and enact the social purpose of the research sector. But Denmark, through a team of ministerial officials and elite scientist members of its Policy Council, also had been a strategic co-architect of the supra-national conditions that ultimately influenced its own governing paradigm:

> Certainly, Denmark has had an influence too. The European Research Council was a Danish stronghold. We pushed for the support of excellence from the European level, because having a strong science base will attract top scientists. But it's a small country so to get the really top level, [without European support] would mean taking public funding away from other areas. Denmark would need a critical mass in order to be able to prioritise our support for excellent [as opposed to strategic] research. That's a trade-off. (Key Informant Interview, Danish Science Policy Council)

In their small country context, Danish officials perceived a lack of critical mass to enable equal parts strategic (policy-led) and fundamental (science-led) research, choosing to prioritise research areas of national importance. To this end, the Venstre government adopted the broad frame of 'green tech' and the 'low carbon economy' as a systemic priority. A 2008 Prime Ministerial speech to the Chinese Academy of Science signalled the priority, declaring: "Denmark's future economic growth lies in green tech and low carbon economies" (Rasmussen, 2008).

As a Danish research "sovereignty niche"(Glod et al., 2009), investment in green tech would be endorsed supra-nationally less than two years later by the EU's launch of its *Europe 2020* economic strategy for "smart, sustainable, inclusive growth" (European Commission, 2010). Thus, from the Cold War geopolitics that catalysed Denmark's Arctic and Ionospheric science program, to anticipating the eventual global need for clean energy technology, the Danish government's interpretation of external geopolitical signals has played a role in shaping the national research priorities. As a small country, to look outwardly and react accordingly is widely seen to be part of the national identity. As one science policy official described it:

> Denmark is a small open economy. We have an open maritime tradition not continental. The cultural personality is much more pragmatic. When you are coming on a ship into a harbour, you have to have all senses open and be resourceful. You need to be able to adapt and renegotiate. Compared to Sweden, Denmark is much more maritime, we are alert and adaptable. The Dutch are said to be like this as well – a small nation on the seven seas and being flexible. You must know what's going on, because otherwise you can't navigate. You need to be very alert. (Key Informant Interview, Danish Science Policy Council)

Completing the reform agenda: Material changes match institutional changes

While the national and supra-national governments seemed to be aligned on RSI, domestically the Venstre government had yet to complete the institutional reforms begun several years earlier. After the university-PRO mergers and the industry-friendly changes to University governance, the government now turned its attention to the decades-old debate on how be fund universities (Aagaard, 2018).

Negotiations between government and the academic community to reach a suitable funding formula for the higher education sector were "lengthy and heated" (Aagaard, 2018). Whereas Danish universities were conventionally funded through largely predictable and guaranteed bulk grants, government wanted the assurance of performance indicators on which to base funding rather than rely on historical precedent. In the end, it asked universities to propose their own performance indicators. They reached an agreement by 2009, to be implemented fully by 2012 (Key Informant Interview, Science Policy Expert). The final formula gave educational performance a 45% weighting, with three research-related indicators making up the balance (bibliometric indicators, the transition of PhDs to the labour market and obtaining external funds). The choice of indicators was itself indicative of government's perception that the research community must not rely on public funding, while serving the needs of the labour market.

In 2011, the conservative Venstre government lost the election to the Social Democrats once more. During their decade in power, Venstre had overseen the most sweeping structural changes Denmark's RSI system had seen to date. They had: reduced and merged PROs and universities; incentivised industry-focused research; and created the conditions to access as much undirected EU funding as possible (European Commission, n.d.-

a) Taken together, this suite of changes was both a reaction to and a driver of the dominant paradigm of the first 21st century decade for research in Europe. That is, internationally excellent research supporting economic competitiveness.

Unlike New Zealand's 'commercial turn' however, the Danish position in Europe meant that its research system need not be as transactional or internally competitive. Instead, the Danish conservative government maintained its focus on long-term research, but paradigmatically, it was increasingly oriented toward industrial development rather than fundamental science or the public policy challenges of societal and environmental wellbeing. These it considered the remit of supra-national European research policy, particularly as the European Commission had launched its flagship strategy *Innovation Union 2020* in 2011, which emphasised societal grand challenges.

7.5 (2011 – 2014) Smart Specialisation

Destabilisation: Seeking (imperfect) balance in a multi-level context

The election of Helle Thorning Schmidt's Social Democrats in 2011 re-introduced welfare-state (under the moniker "wellbeing") policy making to Denmark which brought with it new changes to the Danish research system. In the typical fashion of a new government, the responsible ministry underwent a telling organisational and name change. The Ministry of Science, Technology and Development was replaced by the Ministry of Science, Innovation and Higher Education, by merging the portfolios and bringing focus back onto the role of the academic community (OECD, 2010). But as new government sought to rebalance sector governance to place Universities more centrally in the RSI ecosystem, it again reinforced its own oversight role. Through an amendment to the Education Act in 2011, Ministerial approval

now would be required for university statutes. As well, ministerial involvement was expected in setting the ten goals that Universities would be required to include in the multi-year performance contracts they held with government to perform the duties of the merged PROs. This move was seen as "part of a general European trend" taking a more utilitarian view of the role of universities (Degn & Sørensen, 2015).

2012 was a critical juncture in Danish research governance for other reasons too. First, the Danish Presidency of the Council of the European Union once again gave Denmark an influential voice in European RSI policy, just as negotiations were getting underway for shaping the upcoming Framework Program 8 (entitled *Horizon 2020*), the premier funding instrument of the European Commission (Borrás & Equist, 2015). In this role, Denmark hosted a the landmark Science in Dialogue conference at which was articulated a European vision for "responsible research and innovation" – a commitment to direct funding toward societal challenges that would become a cornerstone of Horizon 2020 European RSI funding (European Commission, 2012).

In championing this new focus for European funding, the Social Democrats helped lead the shift in Europe's interpretation of the social purpose of research beyond economic competitiveness and initiated the diversification of the research systems of member states. They would be driven by the incentive of unprecedented supra-national funding made available within the European Framework Program, to focus research on societal challenges deemed important in the European context.

This European-level focus on societal challenges remained fairly market-oriented as the European Commissioner for Science and Innovation (who hailed from the highly market-

oriented Irish Innovation system) called for "solutions, products and services" to meet the growing shared population and environmental challenges of the early 21st Century (Science Business, 2013). Critics lamented that this interpretation of the social purpose of research recast the role of the public as consumers of research outputs rather than as engaged citizens with normative views on how science and technology should (and should not) be applied in the public interest (Macq et al., 2020).[79] But this interpretation was nonetheless aligned with Denmark's own ambitions for its domestic green economy, making it easy for the Danish European presidency to support.

Denmark also used its Presidency to champion the view that promoting research 'excellence' was the primary way to meet such challenges (Holm-Nielsen, 2012; R. L. Hudson, 2012). On the surface, this perspective might seem incompatible with Denmark's notion of market-oriented research to respond to societal challenges. Indeed, recent global science policy debates understand research 'excellence' as a funding criterion that contrasts with funder-directed 'relevance' criteria such as responding to societal challenges or market opportunities. However, in the 2012 European context, to call for excellence focused funding from the European level was another way to say that the Horizon Europe Framework program should prioritise investment in research intensive countries, rather than build capacity in lower performing countries and promote European cohesion. Thus, in this uniquely European

[79] Macq et. al 2020 argues that the 'public as consumer' rather than 'public as citizen' in the relationship between science and society was the natural result of the flagship Framework Program (Horizon 2020) being drafted by an epistemic community of economists and management consultants in Brussels, with no expertise in the critical social science such as Science and Technology Studies). This marked a break in the way 'public engagement in science' had been viewed in Europe, moving from the tenets of deliberative democracy to a linear innovation-driven paradigm.

RSI policy landscape, Denmark seized the opportunity of the EU Presidency to play a role in shaping the European understanding of both the purpose and the means of public research. In turn, European funding would complement Denmark's own national system in the ongoing co-evolution of multi-level RSI governance.

Another event that made 2012 a critical juncture came in June when the European Research Area function of the European Commission conducted an expert peer-review of Danish RSI system as one of three agreed case study countries in Europe. Its September 2012 report found the Danish research system to be high performing and internationally competitive in terms of scholarly and industrial output. But its governance regime was deemed overly complex and fragmented. Years of layering on new structures in a bid to circumvent or harness paradigmatic tensions in Denmark had created a legacy of structural complexity (Expert Group for European Research Area Committee, 2012).

Inaugural national science strategy: An attempt to reconcile competing rationales?

Finally, with the apparent strategic benefit of an external validation through a review exercise, combined with and the policy signals that Denmark itself had helped to initiate at the European level, the Danish government launched its inaugural national strategy for the public RSI system in late 2012.[80] Entitled *'Denmark, A Nation of Solutions'*, the strategy's subtitle promised "enhanced cooperation for innovation in enterprises," in reference to the recently re-framed role of universities to support industrial innovation (MSIHE & MBG, 2012).

[80] Though the previous government's 'Globalisation Strategy' had been a de facto science and innovation strategy and showed the implicit framing of science for economic development.

In launching the strategy, the minister implicitly reaffirmed the central focus of his government on innovation and skills, making no mention of science and research:

> With the innovation strategy, the Danish government will ensure that the substantial public investments in research, innovation, and education will translate to more growth and job creation. Part of the rationale behind this innovation strategy is that we need to become better at finding solutions to the global societal challenges. (MSIHE and MBG 2012, p. 3)

Like European RSI policy discourse of the time, the new Danish strategy articulated a specific interpretation of the social purpose of public research by linking higher education investment to economic growth. But it was not to be just any type of growth or support to incumbent industry. Rather, there was a deliberate effort by government to steer both Higher Education and market forces toward developing 'solutions' to shared problems in the public interest. In other words, the new Danish strategy adopted a Responsible Research and Innovation framing that the Danish Presidency of the EU in early 2012 sought to help articulate for Europe. This framing directly addressed the perceived dual policy rationales of the public research system (public service and support to industry), while emphasising a particular kind of mutual reinforcement designed to downplay any tension between them. That is, universities were expected to provide knowledge and skills for industry to develop technologies to solve societal problems.[81] There was no emphasis on any role universities may have as social critics.

[81] The emphasis on industry-led 'solutions' marks the discourse both temporally and ideologically when compared to later more nuanced understandings of the interconnectedness of societal challenges. Whereas technological solutions are understood to have a place, a there is a growing global discourse regarding more comprehensive societal 'transitions' rather than strictly technological solutions and 'solving' discrete challenges (European Commission, 2021; International Science Council, 2021).

This framing contrasts with the distinct dual discourses in New Zealand, where there had been an apparent institutional line between the role of universities and of public research organisations. In New Zealand, industry-facing research was within the PRO remit. But the conservative government of the time made use of the contestable funding system to incentivise (rather than direct) industry-facing research within universities too. By contrast, successive Danish governments used a more direct approach, which sought to institutionalise university-industry links within the system (e.g., through university governance, performance contracts, co-located PROs, industrial PhDs, and ministerial portfolio realignment combining innovation and higher education policy rationales). Moreover, the Danish Social Democratic government went a step further by explicitly building societal outcomes into innovation policy rather than relying on market forces to produce these outcomes. In doing so, Denmark's small size was represented as an asset for placing solutions to societal challenges at the heart of strategic economic development:

> Denmark's size and well-organised model of society should make it possible to turn societal challenges in business opportunities. (MSIHE and MBG 2012, p. 15)[82]

To underpin its integrated policy rationales, *A Nation of Solutions* also sought to integrate research performers even further and addressed the changing role of Higher Education in Denmark. Among the objectives for this sector, the strategy promised to provide

[82] The strategy emphasised the following priority areas for innovation-based economic development: Maritime industries; Water, Bio environmental solutions; Energy and Climate; Tourism and Leisure; Creative design; Health and Welfare solutions; Food; ICT and digital. Within this, the Danish pork industry, which is controversial for its role in water pollution and greenhouse gas emissions, could not go unaddressed in the strategy. The ministry promised to commit research resources to finding sustainable ways of reducing the environmental impact of pork production.

programmatic support and formal career-building recognition for academics collaborating with industry.

In this way, the government seemed to be deliberately shaping perceptions about university *culture,* now that the sector's governance reforms had created the structural conditions for more directed, industry-focused research. While *A Nation of Solutions* did acknowledge academic freedom, it was by way of reminding researchers that with this privilege comes expectation:

> There is a clear need to increase the societal effect of investment [in higher education] and to translate the degree of freedom at the Institutions of Higher Education, especially Universities, into considerably more cooperation and knowledge exchange with private enterprise in the future. This is a call for radical change in the culture of the education. (MSIHE and MBG 2012, p. 23)

The strategy came on the heels of the effects of the Global Financial Crisis in Denmark. If the Prime Minister's trip to China at the turn of the millennium had been a catalyst to focus and invest in the science and research system for economic returns, then the GFC seemed to bring both disappointment and consolidated resolve:

> Coming out of the 1990s, science policy was essentially substituted with technology policy and then technology policy became more closely integrated with industrial policy. […] The Financial Crisis hit in 2009-10 and the politicians stood up and said 'Science weren't you supposed to deliver economic growth? You've cheated us and we've poured so much money into the system. (Key Informant Interview, Danish Science Policy Expert)

In developing the national RSI strategy therefore, the Social Democratic government had embarked on a broad multi-party and multi-sector consultation which it saw as a prioritisation process for strategic research funds. As a result, two 'ideas catalogues' were

launched: *Research2020* aimed at university and public sector researchers and *INNO+* aimed at industry. In a message to the research community, the Minister stated that:

> The [Research2020] catalogue will now form the basis for decision when the Danish Parliament decides how to allocate the strategic funding of research. Not by predicting the next research breakthrough or commercial successes, but by giving priority at a general, strategic level and thereby creating the best possible framework for excellent research and consequently the development of new knowledge and insight. In this regard, I would like to emphasise that RESEARCH2020 is not an expression of the political priorities of the Government or the other political parties behind the project. The catalogue is the result of an extensive mapping and dialogue process. […] I hope that the publication will also be an inspiration in the prioritising of research funds for example within universities, national laboratories, and private foundations. And that RESEARCH2020 may inspire the individual scientists to commit themselves even more to contributing to solving some of today's significant societal challenges. (MSIHE, 2012)

As an industry-facing counterpart to Research2020, the INNO+ catalogue was intended to:

> […] identify particularly promising areas of innovation for Denmark, on the basis of special Danish knowledge and commercial preconditions which can support increased export, growth and employment. […] INNO+ is to contribute to an occupation of the public innovation investments from an output-oriented to a more demand-driven focus. In this way, INNO+ is to be used as the basis for the prioritisation of the topics for the future societal partnerships. Furthermore, INNO+ is to function as a source of inspiration for a wide range of innovation players. (MSIHE, 2013)

With its new strategy and the ideas catalogues to help operationalise it, the Social Democratic government seemed to be intentionally addressing and trying to link both public and private interests. By contrast, the previous Venstre conservative government defaulted to emphasising private sector innovation in its interpretation of the social purpose of the RSI system. But the Social Democrats' balancing act, coupled with their apparent desire for the research system to inform broader public policy goals, would require government intervention, even while they took pains to point out that their aim was only to inspire and not to steer action. In this way, government seemed to recognise that 'picking winners' would

be unpopular with some industrial actors, while academics would remain protective of their autonomy in the interests of scientific integrity.

In the end, neither side of the system seemed particularly satisfied. As one well-placed observer and Danish science policy expert put it:

> Industry said, 'these guys cannot make industrial policy'. They were pretty critical about the whole merger of science policy with industrial policy

Tensions were such that in early 2013, the Minister:

> […] cut out – very dramatically – the whole innovation portfolio (25-30% of personnel) from the ministry and placed it in an independent foundation. (Key Informant Interview, Danish science policy expert)

The stated aim of Innovation Fund Denmark (worth 1.5 billion DKK) was to fund and support the topics derived through INNO+ process although the policy-making capability remained within the Ministry. This new foundation also amalgamated three bodies that had been established previously for technology and strategic research. Coming into effect on April 1, 2014, the foundation was another structural and conceptual turning point in Danish RSI system governance:

> The ministry placed all their innovation activities almost exclusively in an independent foundation, so this makes room for the whole new trajectory which is the merger of education and science policy […] You would think that that is a natural relationship but that got lost in the move towards innovation. But now that this intimacy dissolved a bit, you can get closer to the education portfolio. (Key Informant Interview, Danish science policy expert)

This changed relationship between the policy portfolios was discursively signalled with yet another renaming of the Ministry. The Ministry of Science, Innovation and Higher

Education lost innovation from its title, only three years after the same government had brought the three strands together.

The overall sense of reform was cemented with a new minister appointed to the (somewhat) new ministry, and the decision to outsource policy advisory capability to the newly formed Danish Council for Research and Innovation Policy. This policy machinery sat at arm's length from the government, which was still smarting from recent criticism of its handling of the industrial innovation portfolio. The Council was intended to engage with both academics and industry experts to make policy recommendations, without the responsibility of funding oversight. But the deliberate split between policy-making and funding lasted only three years, until the returning right-leaning Venstre government re-centralised it into the Ministry operations in 2017.

7.6 (2015 – 2019) Swing Right Brings an Innovation and Efficiency Focus

Denmark's swing to the right returned Venstre to power in June 2015 with coalition support of the anti-immigration Danish People's Party. Along with a new minister for Science and Higher Education, the coalition government appointed a new undersecretary, specifically for her previous experience as head of the Danish Competition Authority in the Ministry of Economic Development. A classical view of market-driven innovation seemed to be back at the centre of RSI policy making.

Yet as the country recovered from the Global Financial Crisis, the new government had little appetite for priming innovation with public investment. It administered a cut of more than 20% to the sector's annual budget, including for the recently established Innovation Fund Denmark. This was the first budget cut ever experienced in the sector,

leaving it scarred and worried (Key Informant Interview, Science policy expert, Denmark). Ironically, it came just as the OECD seemed to be advocating increased science and research expenditure by national governments. In its landmark update of the *Frascati Manual* in 2015, the OECD reiterated that research science and innovation expenditure would be counted as an investment rather than expense in the national leger (OECD, 2015).[83]

Ignoring supra-national ideational pressure, government completes its structural agenda

Under Venstre, Denmark's 2015 RSI budget retrenchment also seemed at odds with the supra-national discourse that had been taking shape at the European Commission level, to which Denmark had previously held strongly. In June 2015 the European Commissioner for Science and Innovation outlined his vision for more openness in science and innovation practices in Europe, from data sharing to scientist mobility. The future of the research process was "global, networked and open," he argued, and Europe should be "leading the way" (Moedas, 2015). This vision was translated into the European Commission's RSI sector strategy in 2016 entitled *'Open Science, Open Innovation, Open to the World: A Vision for Europe* (European Commission, 2016). While the strategy recalled the promise of the cohesive European Research Area, the Venstre government's unprecedented cuts in public funding for

[83] The 2015 version of the influential Frascati Manual of national RSI system indicators was the first update since 2002 and only the second since the launch of the manual in 1963. The 2015 version codified in indicators the 2008 change to Systems of National Accounting which now treated R&D expenditure as "capital forming" investment. Thus, in the competitive world of OECD league tables, this should have been the type of justification needed by national Treasuries to lift investment for public research and innovation, not to lower it as Denmark had done. In addition, from a discursive perspective, it is perhaps noteworthy that the 2015 manual bore the image of melting polar ice on its cover. Compared to the 2002 cover image of a stylised digital network, the 2015 image sent a clear message about what kind of research and innovation the social utility of research should now encompass. Coming from the epicentre of global discourse and advice on economic competitiveness, the image of the melting arctic was all the more symbolic (OECD 2015, p. 28)

the sector were sending a different message from the very country that had once been instrumental in establishing the ERA. Still, the cuts were consistent with Ventre's desire to see more of the public research system funded externally.

Instability in Denmark's RSI governance regime continued into 2016 when Venstre replaced its Minister for Science and Higher Education less than a year after the election, only to change ministers for a third time by the end of the year (the 4th minister in 4 years). The shuffle came as Venstre announced yet a new round of budget cuts in the sector and re-inserted the innovation policy portfolio into the ministry after it had been outsourced by the Social Democrats to quell accusations that they were attempting to pick winners. Venstre's motive was different; it sought to rebuild the ministry's internal industry liaison capacity thereby ensuring an industrial voice across both innovation and higher education portfolios.

Of course, the links between innovation and education portfolios had never disappeared entirely because of the longstanding institution in Denmark of supply-managed higher education based on labour market needs. But, as one interview participant explained it, "now the definitional power to set the agenda has changed a lot."

> Now you have a new situation where the Foundation for Innovation is driving up their expectations because they are the sole agency responsible for innovation policy. They have a whole unit in government that is actually going to deliver on innovation impact. This is not a trivial issue. They are starting to require universities to do more in terms of capacity building and value-chain management. So, they need the right structures to be in place at the production side of knowledge… (Key Informant Interview, Danish science policy expert)

Thus, under Venstre, the ministry set about rebuilding not just innovation policy expertise, but specifically the expertise at the interface of innovation and higher education. From this foundation, they revisited the university funding formula that they had established nearly a decade before. In seeking to 'get the structures' right for innovation, universities

would still receive the bulk of their funding based on historical budgets, but outcomes-based shares would be awarded based on student success and employability of graduates in industry. In addition, the potential share to be awarded for research excellence was lowered and made subject to an additional performance criterion based on fulfilling areas of "political prioritisation" within the universities' framework contracts with government.

A new strategic plan and budget entrench the conservative government's view

The new funding formula had multi-party agreement in parliament and was largely seen as a better deal than previously for regional universities outside of Copenhagen, however the incentive to meet government priorities was controversial (Myklebust, 2017a). Once again under the conservative government, research and science policy became synonymous with innovation and industrial policy and merged with higher education policy in the conservative government's interpretation of the social value of public research.

Working out the details of the new funding formula became a pillar in the Venstre's latest strategic plan for the RSI sector, launched in early 2018. Compared to the Social Democrats' inaugural national strategy and priorities catalogues, the Venstre-led government's national strategy was a light-touch document with two central aims: Excellence ("Danish research must be of the highest international quality") and Impact ("Research must provide the best possible benefit to society"), which was largely interpreted as technological development (MHES, 2018). To deliver on these aims, the strategy outlined seven initiatives.[84]

[84] The seven initiatives included establishing a 'Nobel Pact' to ambitiously fund the highest quality research; finalising the model for distribution of funding to universities; a review of university career paths; strengthening international cooperation for innovation (by establishing the eight 'Innovation Denmark Centre', this time at MIT in Boston in 2019); and activities to prioritise technological innovation, including improving tech transfer from universities (Myklebust, 2017b).

These projects aimed somewhat predictably at balancing excellent research (creating a 'Nobel Pact') with greater university impact, with an emphasis on technology development.

A novel element of the strategy was in how it was operationalised. For the first time, Denmark's significant private philanthropy sector would undertake more strategic collaboration with government[85]. The Danish model of research philanthropy is a unique feature of the structural (institutional and material) landscape in Denmark and is a significant source of research funding for both private and public sector researchers. Yet previously, collaborative planning between private foundations and government was rare. It may not be a coincidence that the move towards funding collaboration came just as the need for better coordination across public and private funders was also pointed out in the European Commission's external 'peer review' of the Danish RSI system, which was being conducted as the national strategy was in development (European Commission, 2020a).

The landmark *Forum for Research Funding,* therefore, was launched in November 2018 to address private funding coordination, but also career paths and even national research infrastructure. In addition, in May 2019, the private foundations and government announced a joint € 134 million flagship program of 'Pioneer Centres' across Danish Universities. Majority funded by the foundations, but administered by government, the first two centres would focus on green technology (Climate and Energy) and artificial intelligence (DNRF, n.d.).

[85] Denmark's Big Four funders are Carlsberg Foundation, the Lundbeck Foundation, the Novo Nordisk Foundation, and the Vellum Foundation

Regime stability or a short-lived window of calm?

Remarkably, neither a change in government in June 2019, nor the onset of the global pandemic in late 2019 and early 2020 scuppered these plans, and the Pioneer AI centre opened in late 2021 (University of Copenhagen, 2021). In fact, the returning Social Democrats did not seem to show the same appetite for organisational restructuring and centralised planning as they had during their last time in government. Perhaps they awaited the November 2019 delivery of the European Commission's peer review report for its potential to offer external sensemaking and confirmation of policy ideas.

When it came, the report's recommendations called for: "building on existing structures to enhance coordination across efforts funded by private foundations and public sector entities, and to create a dialogue about strategic collaborations" (European Commission, 2020a). And indeed, the returning Social Democrats appeared to take seriously these recommendations when they amalgamated ministerial capacity to deliver the new university funding model and followed through with the previous government's Pioneer Centres program.

7.7 (2020 -) Global Shock, Recovery, and a Changing Supra-National Context

The research system advice from the supra-national European level was especially important because much of the discourse by the end of 2019 had been about negotiating the upcoming Framework Funding Program which would replace *Horizon 2020* for the period 2021-2027. Labelled *Horizon Europe*, the new Framework Program recommitted to supporting – and expanding - the European Research Area, which Denmark had been instrumental in helping to build. Like its predecessor, the new Framework Program was designed to set the agenda

for research funding for member states and served as a tool for policy alignment and researcher mobility for the ongoing and overarching European integrationist project.

Some key concepts were already in play for Horizon Europe. First, it would be ambitious, setting a funding target of close to €100 Billion and seeking member commitments to lift their national RSI funding to 3% of GDP, finally. Conceptually, it presented five research missions designed to support Europe's emerging *Green Deal* strategy for which "mobilising research and fostering innovation" was seen as the central operational modality (*Communication from the Commission: The European Green Deal*, 2019). [86] Announced in December 2019, the Green Deal was billed as a "roadmap for making the EU's economy sustainable by turning climate and environmental challenges into opportunities across all policy areas and making the transition just and inclusive for all" (*Communication from the Commission: The European Green Deal*, 2019). As such, the New Deal mobilised both 'solutions' and 'transitions' framing. It focused on all sectors of the economy including transport, energy, agriculture and the built environment to achieve the ambition of becoming the first climate-neutral continent by 2050[87].

A more assertive supra-national government seeking institutional & ideational alignment

[86] Designed to support the European Green Deal, there were distinct missions for Digital transitions (Europe fit for the Digital Age), Mission Cancer (Beating Cancer Plan) Mission Climate (supporting the Climate Adaptation Strategy), Mission Soil (a flagship initiative of the Long-term Vision for the EU's Rural Areas) and the New European Bauhaus.

[87] The EC's emphasis on green technology and carbon-neutral energy was likely as much geostrategic as it was out of concern for the climate. Europe's reliance on Russian energy had become increasing unnerving - a worry which was borne out by the Russian invasion of the Ukraine in early 2022. Germany in particular had long been keen to see science and innovation deliver energy independence (Van Elst, Policy Horizons Canada, personal communication).

As a Framework funding program, Horizon Europe's orientation around these research missions was asking a lot of member states. The New Deal's novelty would require considerable coordination across nations and sectors (including public and private). From the outset, the Commission had intended that national public research systems – including private actors – be mobilised and aligned to support the goals because achieving them was beyond the scope of what the Horizon Europe budget could deliver. Missions would also engage citizens and local authorities so that societal and institutional frameworks of member states (laws, markets, norms and practices) could increasingly be oriented to the collective cause. It would be an exercise in transnational policy alignment of unprecedented scope, justified by a shared understanding of the collective challenges facing Europe, which echoed many of the UN Sustainable Development Goals.

The transformative intent of *Horizon Europe* would necessitate a sophisticated governance structure and a set of governing commitments of member states. However, the previous European research governance framework through which funding had been delivered had not set binding goals on member states or associated countries in return for access to the funds. Now in *Horizon Europe*, the incoming EU Commissioner for Research and Innovation, Mariya Gabriel, seemed ready to be more directive about achieving a shared vision, including commitments from member states to align their national research agendas. Also at stake in the governance negotiations was the level of access for non-member states.

Global Shock: Supra-national response to pandemic

The European funding negotiations were put on hold, however, and the yet-to-be-launched *Horizon Europe* Funding program had to be temporarily reoriented as Covid-19 made its way across Europe in the winter of 2019-2020. The European Commission realised

quickly that research and innovation would be central to the response, even before the pandemic was declared by the World Health Organisation (WHO). By the end of January 2020, the first research funding call in what would become the EU strategy for COVID-19 vaccine and therapeutics development was launched (*Communication from the Commission: EU Strategy for COVID-19 Vaccines*, 2020). Other calls would follow, including support for identifying and adapting candidate vaccines, of which BioNtech's mRNA (originally developed with partial Horizon 2020 funding as a potential cancer vaccine) was showing promise at the time. This redirection of Horizon 2020 funding and the 'pre'-purposing of its successor program's funding (Horizon Europe) already amounted to €1billion by September 2020.

At the same time other global actors were coming on board with a combination of public and private funding.[88] The result was an unprecedented global research and innovation governance effort to coordinate national funding and research agendas towards pandemic research. It saw private philanthropic actors such as the Wellcome Trust and the Bill and Melinda Gates Foundations exert a new type influence, not just in grant-making but in explicit policy action, on research agenda setting, on data sharing agreements and on supporting equity of access to research results and knowledge and eventual products (vaccines) for low- and middle-income countries (United Nations, 2020).

[88] Early coordinated global funding included the March 2020 launch of the Bill & Melinda Gates Foundation, The Wellcome Trust and MasterCard COVID-19 Therapeutics Accelerator, with an initial budget of USD 125 million. Many other public/private consortia followed.

Denmark's science-led response grounded in public-private partnership

Denmark was one of the first European countries to impose social restrictions during the week of March 10th, 2020. Its response included a generous economic assistance program to help promote public compliance. The national response was also predicated on mass rapid testing and contact tracing. These activities were enabled by a rapidly negotiated government partnerships with Danish pharmaceutical giant Novo Nordisk and software developer Netcompany (Ornston, 2021). That Denmark could efficiently mount both an industrial response and the institutional settings that enabled it may be attributable to its closely bound neo-corporatist style of government decision making (see **appendix 1**), a main tenet of which is to systematically consults formal stakeholders. In this context, the recent rapprochement between the ministry of science and industrial research foundations to hammer out new terms for coordination and collaboration more generally, must also have seemed like fortuitous timing. Flagship international research collaborations were also established including the regional Nordic Health Data Research Project with Estonia, Latvia, Iceland, Sweden, Norway and Finland and other projects negotiated through the European Research Area's 'EUREKA' Network or member states (OECD, n.d.-b)

Embedding the supra-national approach: European Framework deal in a changed geopolitical context

As the pandemic wore on, the global context and multi-lateral, multi-level dynamics of negotiating Horizon Europe were unprecedented. Not only was the pandemic redirecting research resources and attention, but European Science Commissioner Mariya Gabriel resumed and redoubled efforts to get members to commit to an 'ERA Pact' that would require domestic alignment of unprecedented scale in return for access to Framework funding. The

Commissioner was requiring members to commit to 3%GDP to RSI expenditure, but the access debate took on a political dimension as well by engaging the question of 'shared values' beyond those associated with scientific integrity and research ethics. For instance, traditional members and friends such as the UK and Switzerland were side-lined because their own relationships with Europe had broken down. Moreover, long-held European suspicion of Russia and China was factoring into negotiations with Europe Union 'associated countries.' As Australia and New Zealand were approached for program membership for the first time, European representatives in these countries emphasised during the launch webinar:

> One of the novelties of the Horizon Europe programme is that it foresees the possibility of associating those like-minded countries with which we share the values of democracy, the values of freedom, fundamental research, academic freedom and which have a strong technological and innovation profile. (EURAXESS Australia & New Zealand, 2021)

In short, the debate around which non-member countries to engage in the Framework Program came at a time when Europe was mired in broader political battles including the fact that Poland and Hungary had vetoed a 'rule of law' clause as a precondition for access to European emergency funds (Zubașcu, 2021). In this context, research policy was marshalled as a diplomatic tool reaching beyond the typical agreements on research priorities and funding. It was a distinct departure from the motto of the previous European Commissioner for Research and Science, who only three years before, had articulated his vision of European science as "Open Science, Open Innovation and Open to the World" (Moedas, 2015). Instead, member states' science ministers now were endorsing an agreement that international research cooperation should be guided by the principle of "as open as possible as closed as necessary." (Zubașcu, 2021)

Only a few months later, that sense of caution and protection for shared democratic values appeared justified. Russia's unprovoked invasion of Ukraine plunged Europe into even deeper crisis than the pandemic had already wrought. This brought renewed interest in science diplomacy and so-called 'science in exile' activities, not least from multi-lateral bodies such as International Science Council and the International Institute for Advanced Systems Research (IIASA), arguably the world's first Science Diplomacy entity, born in the aftermath of WW2 (ISC, 2022; Stone, 2022).[89] Science diplomacy quickly became a regionalised concern too; As a member of the Arctica Council, Denmark joined Canada, Finland, Iceland, Norway, Sweden, and the USA in condemning the actions of then Council Chair, Russia. In so doing, it underscored the principles of "sovereignty and territorial integrity" (US Department of State, 2022). Members committed to pausing all Council business under Russian chairship. This included the six working groups of the council, of which scientific research and monitoring was an important part. One can imagine how a volatile Arctic must bring a complicated sense of déjà vu for Denmark.

The foregoing chronologies of the Danish and New Zealand RSI governance regimes, across the fluctuations of distinctive policy periods within dominant, if unstable paradigms, have demonstrated the multiple factors driving change and the struggle to stabilise and settle on a unified vision (and therefore operational structure) for the sector. The following chapter now breaks down this analysis according to how institutional, material dimensions were interpreted into new ideational frameworks that shaped the governance regimes.

[89] For instance, by instituting sanctions affecting scientific meetings, and funding for Russian research and repurposing current Horizon funding to accommodate refugee and exiled scientists.

Chapter 8 Case Discussion

8.1 Introduction to Comparison

Constructivist Institutionalism is interested in the processes of normalisation and institutionalisation of ideas into underpinning interpretive frameworks (paradigms); the self-reinforcing application of these interpretive frameworks; and their destabilisation and replacement over time. But the goal is not only to uncover and trace these processes. Using its multi-focal lens, CI also tries to understand the interplay of factors that create the conditions for these processes to take place.

Perhaps the best summary of what CI aims to reveal came in a 2017 report by the Danish Council for Research and Innovation Policy. The report emphasised the interacting factors that influence the shape of the public research system but also revealed that actors harness these in conscious and deliberate ways to maximise their benefit and minimise consequences:

> […] the reality is that the system is constantly being influenced – from internal and external forces. The challenge is therefore for both the policy level and the research sector to take advantage of the interaction between stability and dynamism to make improvements on a continuous basis. (DFIR 2017, p. 53)

The following sections parse these forces within material, institutional and ideational dimensions, comparing and contrasting the interactions across the case studies.

8.2 Material Dimension

Starting with New Zealand, the small size of the country and limited capacity (financial and human) of its public research system is an important material factor that forces prioritisation of resources. But size is not the only material constraint. Geographic isolation from capital

and skilled labour metropoles has meant that the public sector research regime has not traditionally benefited from the investment by research intensive industries, whose presence in a country has been shown to foster symbiotically a public sector research ecosystem. Isolation also has meant that New Zealand has not enjoyed the level of ideational input and exchange from an epistemic community of policy experts and professionals that would be found in similarly sized countries in the Europe. The combination of material constraints and isolation have made it challenging for ideas about the purpose of public research and modalities to achieve it, take root in any systemic way.

Instead, the context-specific juggling act of resource allocation endures. While New Zealand tends to prioritise investment in socialised welfare and insurance schemes, for instance,[90] justifying investment in the public research system has required an emphasis on short-term impacts and national relevance. Actors seeking to broaden the scope of what is considered impactful or relevant have had to mount a convincing argument that 'return on investment' can be substantial, albeit indirect. Such an argument has required a sustained process of discursive embedding of the idea by ideational entrepreneurs like the Chief Science Advisors, to overcome the powerful influence of a materially-focused lens aimed at government's policy priorities.

By contrast, despite Denmark's disruptive structural reforms of the RSI system in the early 2000s, stability was nonetheless derived from the fact that Denmark achieved the

[90] NZ has a mixed system of private, but largely socialised health and education services, non-means-tested superannuation scheme, 4% of the population are public housing tenants. On top of this, a socialised insurance scheme (supplemented by private levies) addresses risks in the seismic natural environment.

aspirational goal of a combined 3% of GDP towards their RSI system.[91] However, from 2015, under a conservative government, this threshold slipped, while external funding increased, with much of it coming from the European Union funding program.

The Danish government's steadfast and multi-partisan promotion of international linkages within the domestic RSI system, may account for the external success. Incentivised by the desire to have Europe fund its researchers, successive governments have incentivised researchers to obtain external funding, by embedding this as a criterion in universities' institutional contracts. The Danish Council for Research and Innovation Policy report in 2017 explains the reasoning, arising from Denmark's inescapable material realities:

> Denmark benefits greatly from being a small country because small countries were forced to look for partners outside their borders at an early stage. A high degree of internationalisation will naturally accompany excellence because the best foreign research environments will always seek to collaborate with others on the same level or better. Danish research benefits greatly from this. (DFIR 2017, p. 53)

In New Zealand, the performance-based funding scheme for individual academic researchers also tried to incentivise externally funded grants, but with less success due to the smaller pool of external funding options. Compared to New Zealand, Denmark's shelter within the larger European Union context supported the aspirations and in part, the material well-being of its research system (Thorhallsson et al., 2018). So too did the philanthropic structure of Danish industrial foundations, which in turn had an institutional driver within Danish industrial law. These were institutional structures that offered material advantage in the

[91] It is one of only five OECD countries to have done so.

Danish context. The next section takes a closer look at the comparative institutional dimension.

8.3 Institutional Dimension

The institutional legacies in New Zealand's RSI system have made it difficult to diversify both how and why the country invests in public research. The sectoral arrangements and objectives that prioritise transactional research funding aimed at short-term goals, which were laid down in public sector reforms of a generation ago, have been perpetuated structurally within the country's RSI institutions, most notably its highly competitive funding system. But it is the combination of chronically limited investment (not yet reaching the aspirational 3% of GDP) and the deliberately competitive system that has perpetuated the transactional and short-term nature of knowledge production. Critics maintain that this has resulted in funding applications that must remain conservative and tightly focused to stand even a chance of being funded. Moreover, because a funding track-record is a key performance indicator for securing subsequent funding, NZ researchers have been deeply incentivised towards a reliable formula that perpetuates entrenched views about how to conduct their research and the purposes it should serve. Some have argued this results in only incremental advances in knowledge about largely well-described issues (Campbell & Pedersen, 2007) (Key Informant Interview, Science Policy Expert, New Zealand).

And, while New Zealand's long held market-oriented institutional arrangements coupled with material constraints encouraged and reinforced a type of transactional research practice, other institutional settings also served to maintain this paradigm, largely by preventing much contestation. That is, a significant proportion of New Zealand's research workforce is placed within CRIs, and as such, remain unlikely to challenge the status quo

governance paradigm. University researchers, for their part have legislative protection of their academic freedom. However structural mechanisms can and have been used to attenuate this freedom. Indeed, despite the supposed stabilising function of such institutions as the PBRF or university governing boards, none has been beyond the reach of governments-of-the-day, whose structural customisation both arose from and helped to perpetuate their own interpretation of the purpose of public research.

In contrast to New Zealand's institutional reliance on the combination of competitive and transactional knowledge production, the main institutional drivers that shape Danish RSI governance are more consistent with the country's coordinated market economy more broadly (Campbell & Pedersen, 2007, 2015). At the same time, there is a significant multi-level influence stemming from Denmark's membership within the European Union.

For instance, in seeking to coordinate knowledge production and use across the Danish system, it seems only the law governing Foundations was out of reach to successive governments who undertook reforms to nearly all other institutional components of the system - from the composition of university governing boards to PRO autonomy. Not until the government leveraged the institutional connection to Europe (through the ERA's peer review), did industrial philanthropic foundations also become a more coordinated and deliberate tool to shape the overall system. The review's recommendations provided external institutional validation for the idea to undertake more purposive coordination between Foundations and government priorities and funding mechanisms (European Commission, 2020a).

Though it was a new development with respect to industrial foundations within the national RSI sector, this type of coordination is consistent with the broader national institutional landscape in Denmark. First, the coordinated market economy (as opposed to New Zealand's liberal market economy) has a long-established tradition of private-public and industry-labour consultation and coordination that helps calibrate investment in where it is needed to improve economic performance and diversification. In particular, government and industrial investment in training highly-qualified personnel has facilitated movement into new high-tech industries (Ornston, 2012). However, such investment had implications for disciplinary balance within the research sector (Key Informant Interview, Science Policy Expert and Council Member, Denmark).

Second, Denmark's consensus-based parliamentary system is less adversarial which tends to facilitate sectoral coordination when parties are aligned on the overall direction. Danish key informant interview respondents consistently indicated that "Science is a consensus vote" in parliament and an uncontroversial area of policy making. This is despite the clear differences of opinion between right and left sides of the political spectrum on the question of nudging industry by setting out system-wide research priorities in a catalogue, which was openly regarded as "a political prioritisation tool" (Key Informant Interview, Science Policy Expert).

Here, the interplay of material and institutional drivers is exemplified by the contrasting nature of debate in Denmark and New Zealand. Denmark's technology-driven economy is seen as uncontroversial and knowledge generating. This stands in contrast to an extraction-based or a heavily agricultural economy like New Zealand's, which invited much debate as industry's negative impacts on ecosystems (e.g. freshwater) became clearer Thus,

to the extent that Denmark's introduction of a research prioritisation catalogue as an institutional exercise was controversial at all, it was due to differing political opinions on the *role* and *reach* of government rather than on substantive matters of research agenda-setting.

That the research agenda or the appropriate balance of industrially focused and public interest research has not been the subject of debate in Denmark as it has in New Zealand may also be partially attributable to Denmark's membership in the European Union. This multi-level institutional positioning contrasts markedly to New Zealand's autonomous and somewhat remote RSI system. European membership and access to the flagship Framework funding program has been a pressure release valve in Denmark. It has allowed government to focus RSI coordination and policy efforts on domestic economic and public priorities while enabling Danish researchers to access European funds for both investigator-led research and collaborative research on shared global challenges. Of course, such access is not free, but Denmark's contribution to the fund also has afforded it a voice in negotiating Europe's science and research agenda and to advocate for Danish material interests within this space (Kelly, 2020).[92]

8.4 Ideational/Interpretive Dimension

As a small country, New Zealand has lacked depth in RSI policy expertise compared to larger research systems, or even just more globally connected small systems like Denmark's. Nor has New Zealand invested in such expertise as Denmark has. The OECD's last national review

[92] Notably, during the writing of this thesis, The New Zealand government announced that it had accepted an invitation by the European Commission to become and Associated Country to the Horizon Europe Framework funding program. The national investment is $37.6 million NZD over four years. The national return on this investment remains to be seen.

of the NZ RSI system predates the Global Financial Crisis and opportunities for trans-national policy transfer through entrepreneurial actors have been limited and not prioritised by government. In fact, that it was only the burden of performance reporting, coupled with perceived lack of funding which prompted the first real reflection on the system in the form of the Science Manifesto (2008) by the Royal Society of New Zealand. Arguably motivated by self-interest in what they perceived to be a fragmented and overly competitive system, the elite researchers' manifesto expressed deep concern about the impact of what they deemed a short-sighted system.

A Manifesto recommendation, the installation of a Chief Science Advisor (PMCSA) would be a critical juncture in the destabilisation of the competition-based governance paradigm. But establishing a new paradigm would require strategic leveraging of the right-leaning government's own agenda of international competitiveness. Without precedent, mandate or template, the PMCSA would become an ideational broker to help elevate and internationalise the government's perspective of the purpose of public research. The gradual shift in perspective was achieved by initiating the Small Advanced Economies Initiative (SAEI), to shine the light of international comparison on the New Zealand system, while remaining mindful of context-specific institutional, cultural and economic imperatives and legacies. In the absence of internal policy capacity or an invitation by the government for an OECD/European style system review, the self-appointed SAEI (under the leadership of the NZ CSA) issued policy analysis, case studies and comparative metrics that, strategically, helped new ideas to take shape within the New Zealand ministry responsible for the RSI system.

At the same time, changes were taking place in the broader normative context of New Zealand's societal values. The public debates about environmental degradation not only

exposed the untenable nature of the dominant economic framing of government's role and priorities, but also exposed the normative challenges that arose when the research regime was presumed be designed by government to serve these. Paradoxically, greater efforts at public engagement with science and research both addressed, but also entrenched, this dissonance between the research system and its changing social and environmental contexts. The contextual conditions of legitimacy for public research were changing and the system needed to adapt.

New ideas such as the National Science Challenges opened a normative space where greater emphasis could be placed not just on collaboration over competition (though in practice, material resource constraints would end up at least partially preventing this), but also on research priorities where public interests could attract as much attention as economic interests. Opening up the research prioritisation modes also brought a greater diversity of voices to the table. In particular, Māori dual concerns for economic development and Kaitiakitanga (stewardship of nature) were emblematic of larger debates in New Zealand over 'productive land use' and conservation. Though not billed as a national prioritisation exercise, the establishment of National Science Challenges helped to shape the direction of 'what mattered' in the public research regime. New and larger research funding tools have multiplied the number of scientific and advisory bodies and with them, the slate of actors and ideas that have increased influence on the system. Treaty of Waitangi obligations and their manifestation in public service reforms have begun to make room for Māori concerns and practices at a systemic level. This has modified the conventional interpretive filters applied to the public research system.

This new attentiveness to ideas about diversity and representativeness within the regime, together with an emphasis on research priorities that require more collaboration and collective action, is consistent with international trends in research governance globally (Borowiecki, 2018; OECD, 2020). However, it is not necessarily the result of influence by these global trends. Nor are changes in the New Zealand system designed to deliver specifically on global challenges. Rather, the current Labour government explicitly sought to harness the public research sector to "deliver a productive, sustainable and inclusive New Zealand" (MBIE, 2021). In other words, just as with past governments across the political spectrum, Labour is looking to the RSI system to deliver on its own policy goals rather than as a way of addressing any globally aligned collective action.

In contrast to New Zealand, Denmark never really saw the tense contest of ideas about the relative balance between public interest and private interest research, and between localised domestic research topics and broader global challenges. Instead of competing, these interests increasingly appeared to align in Denmark because neither its traditional industrial sectors nor its innovation frontier threatened the public interest. In fact, Denmark's knowledge-based economy (as opposed to a polluting or extractive one) is well established. Thus, for science and research policy makers to apply a decidedly economic lens did not stoke much controversy. Nor did Denmark deny the importance of internationalising the research sector. Instead, it was quite the opposite, with government incentivised by European funding and researcher mobility.

To be sure, Denmark's right-leaning Venstre government's famous "idea to invoice" campaign did cause a stir among university academics when it was introduced, but the controversy may have been directed more at the concurrent challenges to university

governance and perceived loss of autonomy by academics. Indeed, as the case study shows consistently through successive governments, the real locus of ideational debates in Denmark has been the institutional framework conditions of the RSI system, and the relative power and autonomy these afforded to its distinct actors.

Ideas have tracked with the political interpretations of right and left leaning governments in Denmark. Venstre sought to be more directive in academia and introduce business-focussed ideas and actors in university governance, while the Social Democrats sought to be more directive in industrial innovation through its prioritisation exercise. These attempts to manipulate framework settings were largely politically aligned, each touching a nerve with the opposition.

At the same time, Denmark is endowed with rich sources of RSI sector policy ideas from within domestic epistemic communities – Aarhus University, Copenhagen School of Business, and recently Aalborg University all have specialty programs and renowned scholars in science policy. In addition, Danish Science Policy Councils benefit from some of the best STS expertise anywhere globally. Thus, there is clearly a keen understanding of RSI system dynamics domestically, which may account for Denmark's relative success in PhD training programs and obtaining European Framework funding. However, that political interpretations persisted regardless of academic expertise in this area, suggested the enduring view of governments, across the political spectrum, that they had the remit to steer their investment in the public research endeavour.

8.5 Conclusion

Both New Zealand and Denmark have experienced ongoing paradigmatic instability, as demonstrated in the fluctuations seen across distinctive policy periods. But while their instability maybe be indicative of an emerging 3rd paradigm, each country's RSI sector is responding to different institutional contexts and material conditions. The New Zealand research system historically has demonstrated an enduring pragmatism that is part of the national character itself. There is an understandable focus on interests and concerns that are largely unique to New Zealand, including biodiversity and innovation in areas of proven competitive advantage for this small and geographically remote trading economy. More recently New Zealand's socio-cultural considerations, as a leader among Pacific nations, are also coming to the fore in the context of Te Tiriti based post-colonial governance.

For all its pragmatism however, it cannot be said that New Zealand's research governance regime is simply plodding along in a path-dependent way, where actors respond predictably to a traditional set of national interests. Rather, since the market-oriented reforms of the 1990s, there has been nearly constant struggle to reach a shared vision of the 'national interest' and exactly how the RSI sector should support it. Indeed, both successive governments have sought to define it in ways that match their own knowledge needs to servicing policy priorities. In this way, and despite researchers' own apparent commitment to disinterestedness, the RSI sector can be seen as a proxy arena for political contest.

For its part, the Danish system has more paradigmatic coherence about how the purpose of public research is interpreted, but less so about how it is operationalised. The relative material comfort offered by access to both supranational and private research funding has meant that Denmark has not experienced the kind of oppositional debates

between economic and public interest framing that were seen in New Zealand, where there was a more explicit assumption that funding one disadvantages the other, due to limited resources and government as the main funder.

Rather, in Denmark the paradigmatic struggle seems to have stemmed from differing views about power and autonomy within the country's traditional framework of coordination across actors. Both academia and industry have sought conventional autonomy, while successive governments have sought to align them, but have approached alignment differently – whether from the right or the left side of the political spectrum.

Part 3 of this thesis now turns to what can be drawn from this multi-factor analysis of paradigmatic struggle in the New Zealand and Danish public research systems.

PART 3 – OBSERVATIONS AND DISCUSSION

Chapter 9 Tentative Observations: How/When/Why an RSI Sectoral Paradigm Develops & Destabilises

Through carefully chosen case studies, this thesis has sought to explore how norms and ideas relate to institutional and material factors in shaping national public research governance regimes. Taking up the constructivists' "Third Wave" in policy studies, the analysis focuses on how actors interpret and respond to contexts to reinforce or challenge the underpinning shared understanding purpose in RSI, and how to achieve it. As such, the first step in analysing each case was to detect periods of calm and moments of regime destabilisation within the two overarching RSI paradigms theorised in the literature, and to note any evidence of a third emerging paradigm, assessed against four signature characteristics. Following this, the processes of construction, institutionalisation and destabilisation of paradigmatic ideas and institutions were traced by identifying and carefully sequencing their tell-tale representations, which are summarised in the appendix.

However, "simply noting such things as evolving policy rationales does not provide satisfying explanation of why they changed" (Macq, Tancoigne, and Strasser 2020, p. 507). In the same way, simply identifying distinctive periods and their paradigmatic connections - however fragile these may be – and then tracking evidence of reinforcement or destabilisation over time does not explain *why* changes occurred. Nor does it explain the apparent increase in frequency of distinct periods, phases of transition, or the recent failure

to settle into stability (in the case of New Zealand) or only tentative and fragile stability (in the case of Denmark).[93]

Gaining insight into these questions not only can help explain how the sector has evolved, but also how it is likely to continue evolving. More importantly, such insight might help show how the commonly occurring dynamics might be purposefully harnessed by those wanting the sector to fulfil emerging '3rd generation' paradigmatic expectations. As discussed in the introductory chapter, these expectations are no longer just about reaching for some non-specific societal impact, but about systemic societal transformations (Mattsson & Benner, 2022). To date however, this newest Transformation Paradigm seems to be more discursively aspirational globally, than it is given effect at the national level.

Thus, while the case chronologies have illustrated *what* has changed in successive periods of rupture and stability within the past and current public research governance paradigms, they could offer only tentative contextual perspectives about why. Part Three now considers the *how* and the *why* of those changes in comparative perspective, which can give us some clues about the prospects ahead. In doing so, it returns to the analytical premise of this thesis – that the shape of the research governance regime cannot be explained from the perspective of a single analytical lens. The explanatory power of Constructivist Institutionalism (CI) is used to consciously move beyond explanations of change in RSI

[93] These observations are made for the period prior to the global pandemic. At the time, New Zealand's Labour government seemed to perpetuate the disruption trend by reversing legislative changes and policy directions made by its conservative predecessor. In Denmark, successive governments seemed finally to find common ground on the shared priority of working with private philanthropy to better coordinate research funding toward societal needs.

governance that rest uniquely on material incentives, structural path dependencies, or the network of connections between policy actors. CI does not force a theoretical choice between these factors, nor between structural or agent-driven factors more generally. Analysing instead the processes of constructing, institutionalising and destabilising shared interpretive frameworks, CI recognises that the main mechanism of change within these processes is the sense-making work of actors whose interpretations are co-constituted with the paradigm itself.

Explanations thus rest on the discourses of shared understanding of the purpose of public research, which are "embedded in actors and institutions" (Macq et al., 2020). Such discourses are the products of actors' dynamics within institutions and of their interpretations of broader factors of political economy and culture impacting on the public research sector. What ideational and ideological palette do they bring to their interpretation of internal and external pressures, path dependencies and material circumstances? And relatedly, why (when and under what conditions) are they influenced by certain pressures while ignoring others or constrained by certain structures, while overcoming others?

In addition to these analytical benefits of CI, the historical perspective used in this thesis also offers many benefits (Arnold & Barker, 2022). For instance, within-case historical comparison can reveal whether a period of stability or instability is exceptional or part of a paradigmatic pattern. Similarly, history can show ideas that endured and those that faded away over time, and we can note the conditions in which this happened. Comparing chronologies across cases is even more revealing. We can take note of whether our observations hold true in more than one country, which may be an indication of relatively strong common influences from outside national contexts.

The remainder of this chapter sketches out the five key observations that were common across and within the case studies. These are:

1. There is little paradigmatic stability recently
2. External pressures, interpreted domestically shape understandings of 'impact' and create instability
3. Investment discourse is used to justify government activism in the RSI sector
4. RSI is a political arena for government
5. 'National interests' persist despite external pressures

Analysed through CI lens, these five observations could help to explain how the governance paradigm for public research has shifted, remains unstable, and may shift again.

9.1 Observation 1: Little paradigmatic stability. None recently

Both New Zealand and Denmark case chronologies suggest that paradigmatic stability is elusive. New concepts take hold and others recede in imprecise ways. There were more frequent changes in policy rationale and corresponding structural and institutional arrangements in recent years, as the struggle to define the sector's purpose and intended impact has intensified and responded to contextual conditions nationally and globally.

Consistent with recent literature, two broad paradigmatic eras in RSI governance are discernible in the case study countries. However, based on the case chronologies, these could more accurately be described as:

1. The foundational years, characterised by institution-building led by elite scientists.
2. The market-based rationale and performance-based governance, intensifying at the turn-of-the millennium in a preoccupation with international competitiveness and economic innovation discourse

Moreover, the granularity of the case studies enabled identification of distinctive periods of policy fluctuation, which were especially frequent in recent years. This suggests a deepening

debate over a common understanding of purpose and the governance approach achieve it, the dynamics of which has not yet coalesced on a new transformative paradigm in the case countries.

In both case histories, early periods were dominated by the establishment of institutions, which had the chance to embed over a relatively long period of time. For example, the largely unsophisticated nature of both countries' research governance regimes during the inter- and post-war years suggests tacitly agreed and uncontroversial missions to create knowledge for national economic development and mobilisation of the research sector to help build/assert national identity. Paradigmatic stability derived from essentially building the foundations of the modern RSI system. With little to no precedent, any change (or more precisely, any development) in the system was uncontroversial and axiomatic. The tacit social contract recognised the legitimacy of the expert research community, who in turn developed systems that would continue to legitimise their expertise.

Following this long period of development, the next most stable period was the broadly neoliberal era with its emphasis on performance accountability as sources of legitimacy. Paradoxically however, while the neoliberal governance paradigm may have been stable, it created an unstable RSI system due to the application of the paradigm's central concept of competition-driven performance and a default market-based framing of the social purpose of public research. By definition, these concepts led to a more fragmented system and the research community's perception that governments lack trust in their ability to self-govern.

Thus, the stable paradigm did not bring about a stable governance regime because its supposedly stabilising institution was, in fact, competition. In New Zealand, this meant public

research organisations effectively competing with universities. In Denmark, it was Universities competing to host PROs and the tense negotiations over the changing governance of universities to reflect market-based imperatives and to install a competition and performance mindset in academia. Despite this fragmentation in governing and organisational arrangements of the period, the paradigm itself endured, reflecting the structural and management reforms of the broader neoliberal era. That is, successive governments shared a common perception of the purpose of public research; Any sense of disharmony in the sector was between academics (feeling a loss of autonomy) and governments, with little obvious disagreement between political parties . Such was the pervasive belief in market-based policy-making of the period.

Closely following and related to the reform period's focus on performance and accountability, was the late 1990s-to-early-2000s focus on national competitiveness through innovation. Arguably it is the continuation and sharpening of the market-based neoliberal paradigm, with the performance and accountability expressing the 'how' and national competitiveness expressing the 'what' of the social contract for public research of the era.

Neither case country appears to have experienced full cycles of paradigm construction processes and stability beyond these earliest periods, however. Although elements of the latter period's preoccupation with international competitiveness endured and appeared to intensify around the time of the Global Financial Crisis, the shock of which also seems to have triggered more intense government scrutiny of the RSI system in both countries. With this scrutiny, the contest of ideas about the purpose of investment in public research intensified.

It is tempting to apply the concept of Punctuated Equilibrium to explain the paradigmatic instability seen in both cases in recent years (Jones & Baumgartner, 2007). However, it cannot be said that there has been a consistent policy image, (i.e., part of the commonly held interpretation of the purpose of public research) to be punctuated by shocks in the first place. Instead, shocks such as the GFC, the pandemic or environmental concerns have been responded to by successive governments in ways that reflect their own interpretive lenses, with the RSI system pressed into service accordingly, as an instrument of government. Indeed, the growing recognition that so-called shocks are in fact the catastrophic ruptures of complex sets of structural tensions has led successive governments to turn to the RSI system with increased ambition and intentionality, each from their own side of the political spectrum and with their own interpretation of how public research could help support an effective policy response. The remaining key observations elaborate on these points.

9.2 Observation 2: Interpreting external pressures shapes views of impact, creates instability

Another observation common to both New Zealand and Denmark is way in which both countries' RSI systems engage with the external pressures, whether brought on by global shocks or broader institutional contexts. As small, resource-constrained systems that nonetheless relied on international validation of their outputs, RSI is naturally susceptible to material, institutional and ideational pressure from outside national borders. Yet, governments-of-the-day in each country tended to interpret these pressures according to their own political priorities to define what the system's outputs and impact should look like. Lack of consensus across successive government created instability in the sector.

External material pressure from shocks

With the exception of the war-time public research effort, the latent effects of the Global Financial Crisis on New Zealand and Danish economies constituted the first significant material pressure on the domestic RSI system. Originating with an external shock, this pressure coincided with a period of intensive fluctuation in the RSI governance discourse and organisational arrangements domestically in both cases, suggesting that the material pressure was being interpreted and responded. To be sure, some of this fluctuation seems linked to the natural completion of domestic structural reforms, but other actions seemed distinctly new. For instance, both countries brought in inaugural national RSI strategies within three years of the GFC's rippling effects. These inaugural national strategies may not have been a direct response to the GFC, but they nonetheless bore the mark of governments seeking more solid and reliable footing through domestic innovation in a volatile global market. They were also both launched shortly after the first post-GFC elections and their resulting changes in government.

In New Zealand, the inaugural national strategy (*Igniting Potential* 2010) was positioned for the newly elected conservative government to champion innovation as a pathway for jobs and economic growth. Similarly, in Denmark's inaugural strategy (*A Nation of Solutions* 2012), the newly elected Social Democratic government directly cited the country's economic challenges and the need to generate sustainable jobs and stability, as the motivating material factor. In both countries, the national research communities seemed content enough with the attention and the material incentives such strategic plans brought to a sector where securing public funding had been (and still is) an abiding challenge.

However, it was the discursive and structural changes to the ministries during this period that were perhaps more revealing. Denmark's 2011 merger of the Ministry of Science, Technology and Development with the Ministry of Higher Education reinforced the government's view of the purpose of the tertiary sector: to develop job skills for an innovation-based economy. The structural coupling also reflected Denmark's highly coordinated labour market and supply-managed higher education system, a social institution of its 'coordinated market economy' (Campbell & Pedersen, 2015; **Appendix 1**) that is both stabilised by, and serves to stabilise, the RSI system.

The same year, New Zealand restructured in the opposite direction. After launching its 2010 strategic plan, government re-coupled the policy and funding functions of the RSI system into a new Ministry of Science and Innovation, only to then merge these into a new (and largely unheralded) 'super-ministry' of Business and Innovation two years later in 2013. This move further emphasized the New Zealand (then-conservative) government's post-GFC priorities to generate jobs and economic opportunity from public research. This time, academics worried about the losing sight of 'Science' in the process, while Higher Education remained completely disconnected from the Innovation Ministry – for better or for worse.

Paradigmatic instability continued during this period despite (or perhaps because of) government's discursive and structural attempts to install their own interpretation of the purpose of public research in the years following the GFC. In New Zealand, the amalgamation of research into science and science into a super-ministry for economic development clearly signalled how government thought about the sector, as it sought to set the framework conditions for growth through innovation. Meanwhile, Denmark's Social Democrats were attempting to engineer innovation through their catalogue of priority research areas to

inspire firms and public research organisations. Neither move was popular among their respective target audiences. New Zealand academics resented the conflation of 'science' and 'research' with 'innovation', while Danish industry leaders worried the government was attempting to pick winners. Though grounded in different domestic political contexts, both countries' actions were emblematic of the volatile period in which external pressure – both material and ideational – prompted governments to explicitly consider the purpose and contribution of the public research sector to domestic priorities. And each one did so within their own ideological frameworks.

External institutional pressure

External influences on the domestic RSI systems in both countries were not limited to apparent material fallout (real or presumed) of the GFC. For Denmark, there was also the multi-level institutional influence of the European Commission, which was embarking on negotiations for the next Framework Program (Horizon 2020) for research funding. Macq and colleagues have shown that negotiations for this flagship supra-national funding scheme had been influenced by the policy network of scholars steeped in Science and Technology Studies who helped seize a window of opportunity to include 'societal challenges' as a major structuring component of the funding envelope (Macq et al., 2020). Moreover, framing of the funding policy in emerging 'Responsible Research and Innovation' discourse compelled Europe's national research communities to demonstrate societal engagement and impact.

In this context, the Danish Social Democratic government's attempt to persuade industrial research to take up particular societal challenges can be seen as emblematic of the multi-level paradigmatic struggle of the time. Broader European ideas about what constitutes societal impact (beyond economic) were being introduced into a domestic policy

environment where the dominant interpretation of the purpose of public research had been about skills, jobs and marketable innovations.

Meanwhile, these post-GFC years in New Zealand saw the introduction of societal challenges-based funding. But for a government that had recently merged its public science and research portfolio into its business and economic development ministry, the new scheme seemed more like a conciliatory nod than the dawn of a new paradigm – particularly as it was not funded with a new money, but a reallocation of existing resources.

This is despite the indirect external influence of the Small Advanced Economies Initiative, an international policy network of which New Zealand's first Chief Science Advisor had been a founding member. The SAEI's championing of broader and more explicit notions of 'societal impact' of research, and their sharing of ideas on novel policy and funding mechanisms helped validate the uptake of a greater societal perspective. However, it also reinforced a paradigmatic struggle in New Zealand's research governance regime. The new discourse shone a light on the ideationally entrenched structural disconnect, which largely favoured a kind of short-term and transactional research, as the SAEI offered new external platform for contestation of research governance ideas.

Comparing the post-GFC changes in the RSI systems of New Zealand and Denmark offers a unique opportunity to observe this period of paradigmatic volatility and the interplay of material, institutional and ideational factors underlying it. The evolving shift from discourses of public research for 'competitiveness' toward inclusion of 'societal impact' in the multi-lateral and multi-level arenas met with different institutional and ideological settings at the national level. In Denmark, the long history of industrial research dominance in the small

RSI system provided the context in which the Social Democratic (Left) government attempted to steer industry to address societal impact through innovation (as though anticipating third-generation governance models). Although the exercise would later prompt the backlash and rebalancing of the innovation policy portfolio within the ministry by the incoming conservative government, the initial idea had received benign support from Denmark's consensus-based parliament. For its part, New Zealand's post-GFC National government (Right) had amalgamated much of the contestable public research budget into its business ministry, but also piloted a new class of funding to address societal impact and engage the public. However, in redirecting intended core funding from public research organisations (NZ's CRIs) to service this impact-driven funding pilot, the conservative New Zealand government did little to solve the issue of short-term transactionalism in its system.

In both cases, the incoming global ideas about a broader purpose for public research had to confront entrenched domestic institutional structures and long-held interpretations of domestic governments. From opposite ends of the political spectrum at the time, Denmark and New Zealand's governments each sought to adapt the new thinking in their own way. Yet, in both cases the dissonance between the emerging global discourse and the domestic institutional and ideological terrain gave rise to paradigmatic instability.

This instability would continue in the years that followed as successive governments in both countries enacted their own interpretations of the purpose of public research in a rapidly changing global context that would impinge on the domestic arena, not least through the collective global action that would be expected from 2015, when the UN Sustainable Development Goals and the Paris Climate Agreement came into effect.

9.3 Observation 3: 'Investment' discourse to justify government activism

As the previous section illustrates, the years 2008 through 2015 were marked by unprecedented (peace-time) external pressures on the heels of the GFC and the dawn of the UN Sustainability agenda. These combined forces translated into interacting material, institutional and ideational pressures domestically. Within this mix, the 2015 update of the OECD's global norm-setting Frascati Manual of national RSI indicators, institutionalised a new idea that appears to have affected research governance domestically.

External ideational pressure

In the 2015 Frascati Manual, public research activities would now be classed not as a national expenditure, but as an investment in a 'value creating asset' (Edworthy & Wallis, 2009). Although this change had already been agreed multilaterally for systems of national accounting, it had not been fully codified in the RSI sector until the Frascati update of 2015.

This new investment framing reflected a view that public researchers and progressive economists had long held - that public support for research should be given due credit for creating knowledge and know-how that underpin private innovation (Mazzucato, 2015). By legitimising this view, the OECD's new metrics would encourage laggard countries to meet the de facto global target of 3% GDP towards the national RSI system – or would at least remove any ideational barriers about spending that countries may have had. Presumably, encouraging increased investment in research, combined with broader view of 'impact' would provide the external endorsement (and OECD-style peer pressure) that countries needed to both shake off lingering effects of the GFC while advancing the sustainability agenda.

However, at the national level, the new investment framing may have had an unanticipated effect. By casting governments as 'investors', the emerging global framing also gave them license to take an unprecedentedly interested approach to the RSI sector, and to be more selective about where and how they would invest, divest and restructure their investment portfolios.

Though it is not possible to draw a direct line between the global discursive shift (even from the influential OECD) and national governance and policy changes, it is nonetheless interesting to note the uptick in government interventions in the RSI sector around 2015. In Denmark, the 'investor' framing coincided with an incoming conservative government. Perhaps unsurprisingly, their intervention was to re-instate the innovation policy expertise, which had been resected from the ministry, to help promote favourable settings for industrial investment. Yet at the same time, Denmark's incoming conservative government also reduced, rather than raised its public spending on research. It was the first reduction to the public research budget in Danish history. Thus, as an *investor*, government was exercising its right to divest as well.

In New Zealand, the conservative government of the time became more overt about adopting the investment framing, as was evident in their second national RSI strategy, the 2015 'National Statement of Science *Investment*' (emphasis added). The strategy linked directly to the government's overarching Business Growth Agenda policy framework by emphasising a return on investment in public research through impacts in innovative products and services, and the development of skills and know-how. Indeed, the more obvious expression of investor discretion perhaps was when the government added "benefit to New

Zealand" as a selection criterion for the Marsden grant, the country's flagship investigator-led funding programme, which had not been intended meet specific public goals.

Thus, paradoxically, the emerging 'investment' framing may have appealed to the public research community for better reflecting the nature of RSI funding in national budgets and for encouraging governments to invest. But in doing so it also gave governments reason to become increasingly directive. In Denmark and New Zealand, this is exactly what happened. The institutionally influential OECD's introduction of an ideational change to its accounting norms and standards may have had unexpected structuring effects on RSI governance regimes when it was re-interpreted domestically.

9.4 Observation 4: RSI is a political arena for government

Comparing the discursive representations within and across cases, it is apparent that later periods were more unstable in both countries, with near constant cycles of tension and contestation across all four paradigmatic features. Moreover, successive governments in both New Zealand and Denmark appeared to be more active in the RSI sector – both strategically and operationally – from around 2015.

Yet, not only were governments taking more liberties with a sector that had traditionally enjoyed considerable autonomy, but the interventions also tended now to oscillate with changes in government. It is not unexpected for an incoming government to overturn decisions of predecessors in an effort to align policy with their own ideological priorities. However, until around 2015, the RSI sector had not seen the kind of ideational

(strategic plans), institutional (changes to laws and ministerial portfolios) and material (funding) fluctuations between governments that signal political activism. The new interpretation of public research funding as an investment had opened the door for governments to be more overtly political in how they directed their support to the sector.

For instance, in both countries, conservative governments tended to view research policy as de facto innovation policy. In their 'investment' rationale, they prioritised commercialisable research and the development of skills for knowledge-based industries. In Denmark, more so than in New Zealand, the innovation emphasis was often expressly directed toward 'green technology' development, which had been a bi-partisan policy priority, but introduced by conservative Venstre. Supporting their 'skills and innovation' framing (and thus investment rationale), another tendency of conservative governments was to create more space for industry within public institutions, both at governance and operational levels. Indeed, the RSI sector appears to attract considerable government attention and intervention under conservative regimes, which have tended to position the sector as a key framework component for economic growth.

Periods with Left-leaning administrations also saw significant government intervention in both case countries after 2015. Although unlike Right-leaning governments, the Left seemed to be more explicit about instrumentalising the RSI sector to achieve broader policy goals, beyond the generic aims for economic growth and workforce development. This is not to say that the political Left appeared more ideological than the Right in its mobilisation of the sector, nor that the Right appeared any less so. However, the Left's operating method seemed more interventionist by design, whereas Right-leaning governments tended to

minimise direct government steering, with interventions focusing instead on ensuring optimum framework conditions for markets to develop and flourish.

Against this background, the attempts of Denmark's Social Democrats to nudge industry through ideational mechanisms such as its Innovations Catalogue, and New Zealand Labour's exploration of more concerted efforts to decolonise science and academe are some examples. In both cases, they reflect the Left-leaning government's attempts to mobilise RSI policy and governance to address broader political commitments that span policy sectors.

While investment framing seems to provide justification for increased government intervention in RSI however, it does not fully explain why this sector in particular has become a key target for government intervention. Here, case chronologies have offered some clues based on the types of interventions favoured by each side of the political spectrum, and their timing. Whether it is primarily to underpin specific public policy goals (Left) or to bolster generic economic growth (Right), the timing of interventions, tended to swiftly follow changes in government. These patterns suggest that the sector is an easy target for politically-driven change because it has neither a significant public constituency requiring consultation, nor a specific policy problem to solve. Instead, it is seen as an enabler and a discretionary investment. As such, it is one of the more accessible arenas in which a government can enact change in its own image.

Swings from Right to Left in the years after 2015 saw commensurate changes in RSI priorities, organisational arrangements and funding mechanisms, reflecting each new government's particular interpretation of the purpose of public research. In short, governments on both sides of the political spectrum tended to view research policy and

governance as an extension of their policy agenda in legitimate accord with their respective electoral mandates.

9.5 Observation 5: National interests persist despite external pressures

As RSI system governance changes tended to track with changes in government, it stands to reason that domestic policy priorities (however these were defined by one side or the other) would take precedence over shared global concerns. This held true even in the face of external ideational pressure that began to appear more explicitly around the Sustainable Development Goals and the commitments of the Paris Agreement on Climate change from 2015 onwards. Indeed, such persistence was observed in both case countries as they continued to pursue domestic policy goals through their respective RSI systems, both by funding strategic themes and by shaping governance mechanisms.

By 2019 however, it no longer seemed self-evident to pursue strictly domestic (economic) interests through the public research system. Influential discourse within the EU and the OECD for instance was now broadening from RSI for national economic growth and competitiveness to national RSI also contributing to collective global action for societal transformation. These global discursive shifts played out in different ways domestically, depending on institutional linkages between national and global scales as well as on presence and positioning of policy entrepreneurs (ideational brokers) within national systems.

In Denmark, membership in the European union and access to the Horizon framework funding program appeared to incentivise research on broader European challenges by offering funding streams beyond member states' own policy priorities. But this did not necessarily encourage more regional – not to mention global - alignment on common

challenges. Integrating effects of Horizon funding were arguably overshadowed by how it relieved pressure on Danish public funding, allowing it to be more focused on domestic priorities. As it happens, Denmark's own niche areas already aligned with many at the supra-national level so the real difference was in the fact that European funding allowed more discovery research while domestic funding could be aimed at research that was closer to application, thereby fulfilling perceived national knowledge needs. This systemic result may have been partly due to Denmark's own early influence in the European Research Area system. The demonstrable national self-interest would again turn up in the heated member-state negotiations with Europe over the latest Framework funding program when they recommenced post-Covid.

At the same time, institutional links to the supra-national level also brought ideational pressure to Denmark from the epistemic community within the European Commission through its peer reviews of member states' RSI governance regimes. The reviews of the Danish system called for less fragmentation and a more deliberate relationship with private philanthropy to address societal challenges. Although this was raised in a 2012 review, it took until 2019 and a conservative government to explore the issue in earnest. Perhaps, the conditions were right, as the conservative government was seeking system efficiencies. It had also recently restored the Innovation policy portfolio within the ministry which may have also restored the trust of private sector players. So, while external pressures raised the issue, it was the direct alignment with domestic concerns and conditions was a factor in adopting the supra-national perspective.

In New Zealand, the physical and institutional distance from multi-lateral agenda-setters (e.g., the OECD, UN and European Commission) seemed to translate naturally into

ideational distance also, and an RSI system remained more focused on national interests – though these would take different forms, depending on the government of the day. Even as the OECD began introducing new metrics to reflect broader societal impacts that hinted at global sustainability concerns in 2015, New Zealand's transaction-driven institutional arrangements helped to keep its system tightly focused on long-held assumptions about the purpose of public research.

For New Zealand's pre-pandemic conservative government, the RSI rationale – mutually reinforced by governance and operational structures – tended to remain fairly narrowly focused on economic growth and skills development under the government's overarching Business Growth Agenda. However, the accepted understanding of research impact did begin to broaden a little through the policy entrepreneurship of the Chief Science Advisor and the members of the Small Advanced Economies initiative, who leveraged the conservative government's interest in the country's international reputation, to introduce ideas from the international arena.

For the subsequent Labour government (from 2017), the overarching Wellbeing Agenda (compared to National's Business Growth Agenda) as the new government's policy framework, set the tone for their interventions in the RSI sector. Although the wellbeing perspective on RSI was consistent with discursive policy shifts in the multi-lateral arena at the time as well, this alignment did not appear to be because the Labour government saw the country as a global actor in this space. Quite the opposite, the incoming Labour government focused even more internally on the unique issues affecting New Zealanders. For instance, in RSI this meant more pronounced efforts to make the sector welcoming to Māori and Pacifika

scholars, while exploring the place of indigenous traditional knowledge within the conventional research establishment.

It was Labour, too, that made the most serious efforts to date at fixing the deep structural problems of an overly competitive and fragmented system, inherited from the neoliberal reforms of the early 1990s. By 2017, the incoming Labour government's interpretation of the purpose of public research had reached beyond short-term transactionalism and commercialisable outputs that the competitive system had catered to and perpetuated. Stating repeatedly since their election that the current RSI system is "no longer fit for purpose," Labour did not expressly give any alternate purpose, but their public consultation on the modus operandi and slate of the Crown Research Institutes was telling. It signalled that new research priorities were on the horizon, together with a greater commitment to *public* interest research, regardless of any apparent conflict with *national* interest priorities that were championed by their predecessor.[94]

The 21st century's changing global context of interacting risks such as climate change and pandemics require shared knowledge for collective action with a long-term view. This understanding is now clearly shared and reinforced by the multi-lateral science policy community, creating growing external pressure on domestic RSI systems. This pressure has remained mostly ideational, but it can also be translated into institutional and material

[94] One of the key structural changes suggested by Labour in their 2021 consultation Green Paper on the RSI system was to address the potential for conflicted of interest in CRIs operating under the Companies Act, requiring them to take commercial contracts to be self-sustaining. The Paper questioned whether this structure would jeopardise research in the public interest, presumably by prioritising more lucrative commercial contracts or by avoiding research that could reflect poorly on commercial customers (MBIE, 2021)

pressure, as is the case with the European Union's Framework funding program, to which New Zealand signed on as an affiliated member in 2021.

Despite the more pronounced multi-lateral pressure, it seems unlikely that New Zealand's recent quest to be more long-term and public-interest focused is a response to external ideational influence. More likely, it is simply the mark of a Labour government that is less invested than its predecessor in the competitive modalities and the political-economy that were well served by status quo research governance regime. With Labour, there is perhaps more fertile ground for ideas to take root about a collectivist and public-interest purposes of the research endeavour. However, any change should not be taken as evidence of a simple transfer of globalist norms and ideas into domestic research policy. Just as in Denmark, research policy and governance are still viewed through the lens of national institutional structures and policy priorities.

The following chapter revisits both the theoretical and methodological underpinnings of this thesis in light of the empirical observations just discussed. It returns to the work's motivating questions to comment on the relationship between institutions, ideas and material factors in shaping the research governance regime, and on the utility of small national research systems as models to study.

Chapter 10 Theory and Methods Revisited: Some Modest Contributions

10.1 How *Do* Norms & Ideas Relate to Institutional & Material Factors in Shaping Regimes?

This thesis began with an underpinning assumption that the shape of national RSI systems was unlikely to be explained by looking only to the material dimension, that is, the utility-maximising role of agents in RSI policy development and change. But nor could it be explained strictly by the constraints of structuring institutions, often presumed to be external to the agents embedded within them. Instead, from the beginning, this study has postulated the interplay of institutional, material and ideational dimensions to account for the rise and fall of evolving collective interpretative frameworks (paradigms) about the purpose of public research and how to achieve it. These interpretive frameworks are understood to be developed and maintained or reworked by ongoing sense-making by actors, as ideas are mediated and embedded or rejected locally. In turn, these frameworks are understood to influence how actors reinforce or dismantle institutions in an ongoing and co-constitutive relationship between structure and agency, according to the basic tenets of constructivism (Jung, 2019).

But while this theoretical commitment was understood at the outset, the relative weight and timing of material, institutional and ideational factors in shaping, reinforcing or destabilising the framework (paradigm) remained unclear at best. At worst, to attribute phenomena simply to the mechanism of sense-making within a co-constituted framework risked committing the very type of theoretical essentialising that constructivists themselves

call out. Thus, the co-constitutive dynamic itself needed further examination to understand, for instance, the conditions under which some factors became more influential than others.

To address this potential theoretical deficit, this thesis applied the methodology of tracing processes of paradigm emergence, institutionalisation and destabilisation over a long period of time. This method offered a fuller and more complex picture of multi-dimensional dynamics in the development of the RSI paradigm and the national governance regime that flows from it. Moreover, applying this methodology across two comparative cases helped to distinguish similarities and differences in the conditions under which material or institutional considerations were foregrounded by actors as they made sense of their context and took decisions accordingly.

It was shown, for instance, that from the largely non-partisan formative years of the public research sector, through to the era of encompassing neoliberalism, interests, ideas and institutions did appear to be mutually reinforcing for a time. This created relatively stable governance paradigms, with few distinctive periods of policy or structural fluctuation, in which the purpose of public research was taken for granted as part of the general business of civic and economic progress.

However, RSI came to occupy a more central place in the case study governments' broader policy agendas as the 'investment' interpretation was introduced and legitimised by the OECD among others. Governments saw the notion of investment as justification to expect more obvious 'impact' from RSI. But the definition of impact and the perceived ways to achieve it were left to the government of the day to define, which implicitly politicised RSI governance and caused institutional instability.

Configuration of national level explanatory factors in Denmark and New Zealand

In many ways, this politicisation seemed more pronounced in New Zealand than in Denmark. The differences between the cases are related to factors in both their institutional context and their political-economy. New Zealand's parliamentary system is inherently more adversarial than Denmark's, and its primary export-based liberal market economy is still comparatively reliant on carbon-emitting activities. Both factors may have made New Zealand more susceptible to debate and the destabilisation of successive RSI governance paradigms, as the sector became a proxy arena for the contestation of ideas in the broader policy agenda (e.g., freshwater standards, decarbonisation, and decolonisation).

For Denmark the main policy debates seemed less about the priorities of the national policy agenda, and more about setting what were perceived as the appropriate framework conditions to achieve a particular understanding of research impact, which nonetheless played out ideologically. This distinction in the type of debate was most evident in the shifting place of the innovation policy portfolio vis-à-vis public research within successive government administrations. It was also evident in the degree of emphasis placed (through performance indicators) on securing external funding, largely from the supra-national European funders. Either way, Denmark appeared to have a stronger consensus than New Zealand about the general purpose of public research and the type of impact sought, but less so about how to achieve it.

From a material perspective, Danish economic strengths are not the contested space that they are in New Zealand. While pork and dairy industries have seen some controversy in Denmark, the commitments of successive governments to strengthening knowledge-based

industries like pharmaceuticals and renewable energy, has in part led to a more cohesive perspective on the purpose and policy rationale for public research investment. Moreover, Denmark's institutional history of coordination between industry and higher education to produce specific expertise in a coordinated labour market is mutually reinforced by these economic strengths. So, with economic interests and public interests generally aligned, there was not a big source of controversy, keeping the governance paradigm largely intact for a time.

However, to the extent that Danish RSI system has been an arena for proxy political debate, the main contest of ideas has been instead about larger institutional framework conditions, both from national and multi-level governance perspectives. Nationally, RSI is a critical flashpoint to address the relative autonomy and influence that industrial actors should have in a coordinated market economy – on which Left and Right sides of the political spectrum hold distinct views. Supra-nationally, the RSI sector has been a key proxy arena in which to debate and understand Denmark's relationship with Europe. This played out most clearly in its discourse over ideational (and material) pressure on European member states to modify national RSI structures in response to negotiations on the latest European Framework funding programmes. For Denmark therefore, it has largely been adjustments to regional and international multi-level pressures – both material competition and institutional constraints – that have prompted shifts in the governance paradigm.

The differences detected in the case histories of New Zealand and Denmark serve to demonstrate that the shape of the public research system results from their respective underpinning governance paradigms, which in turn can be explained by understanding the broader institutional and material dimensions of country contexts, and the interplay of these

as they are interpreted and responded to by decision-making and pressure actors in a co-constitutive way.

The multi-level politics of RSI in a changing global context

The preceding analysis is incomplete, however, without considering the multi-level dynamics and global backdrop of national RSI systems. As the conceptual model in section 3.3 posits, the national RSI sector is inherently global by virtue of the globally connected *research* community in the first instance, but there are also distinctly global *policy* influences at play. Interacting ideational, institutional and material influences at the global level have increased and evolved considerably in the past decade with the accelerating reality of climate change, the digital revolution, the aftermath of the pandemic and growing inequities felt globally.

Against this backdrop, global and national political interest in the RSI sector has intensified. With it, so too has the paradigmatic instability, as national systems established to serve an earlier (and implicit) RSI governance paradigm are now losing resonance with the rapidly changing global context and pressures to change norms about what constitutes progress in the face of perma-crises (Diercks et al., 2019; Schot & Steinmueller, 2018). Indeed, global science policy actors have pointed out that complex global challenges require transformation of socio-technical systems such as energy, agriculture transportation and finance (McGuire & Paunov, 2022; OECD, 2023a). And further, that these needs are not well served by a growth-driven RSI systems that are organised around conventional disciplines and competitive funding modes.

Global norm-setters have thus started to raise awareness of the need to *intentionally* establish a new governance paradigm that supports strategic, coordinated and collective direction-setting and open and accessible knowledge production (International Science

Council, 2021; The Royal Society, 2021). To this end, in just over a decade, various collaborative institutional platforms have been established to actively construct a new shared vision of the purpose of public research and to coordinate efforts to achieve it.[95]

Supporting these institutional innovations in the international arena, there have been significant ideational shifts from influential global voices. These have become more pronounced since at least 2015, the year of the SDG launch and the Paris Climate Agreement. The OECD's policy discourse is especially telling in this regard. Its flagship science policy publication entitled 'STI Outlook' attests to the evolving policy priorities, the changing perceptions of purpose, and the increasing directionality of national RSI governance between 1998 and 2023, the period for which this biennial publication is available online. Whereas the series began by simply highlighting policy framework conditions to support (undifferentiated) innovation and productivity through science and technology in the late 1990s, it moved on to give platform to ideas about societal (not just economic) goals for the sector and green innovation by the 2010s. By 2023, it was expressly calling for national government intervention in "designing policies that can enable sociotechnical transitions" including by

[95] For instance, in 2009, a consortium of research funders and international science organisations launched the Belmont Forum, a ground-breaking multi-lateral research policy and funding platform enabling state and non-state funders to contribute to a joint effort in sustainability research (Belmont Forum, 2017). In 2012 the Global Research Council launched as a community of practice for national Heads of Research Councils. The self-organising GRC offers an arena for the exchange of policy ideas on funding mechanisms, and for collaborative prioritisation and funding (GRC, 2020). And in 2015, the launch of the UN Sustainable Development Goals was accompanied by the launch of the STI Forum, an annual gathering of member state funders and ministers of science as well as non-state actors dedicated to shaping the sector's framework conditions and funding mechanisms to favour more collaborative transboundary research and innovation transformative potential (UNDESA, n.d.).

"enabling new markets to emerge" (OECD, 2023a p. 13)[96]. These ideational developments demonstrate a normative turn, a broadened perception of purpose, and the disruption of conventional research and innovation assumptions. They are all the more significant given their distance from the OECD's institutional and ideational roots in classic economic and innovation theory, and the OECD's reach with this new messaging.

The OECD's discursive shift foregrounds the role of new ideas in generating institutional reforms that can help respond to changing material conditions at national and global scales. This discourse is part of a growing international epistemic community of science policy scholarship that is challenging the very institutional assumptions that the OECD itself helped to establish through years of policy advice and measurement exercises. From fixed disciplinary boundaries to the underpinning 'National Systems of Innovation' approach, assumptions about how research is organised and applied are now being tested by new demands in the changing global context for knowledge (Borrás, 2020; Borrás & Schwaag Serger, 2022; Schot & Steinmueller, 2018; TIPC, 2021).

With an increasingly purposeful approach to RSI governance, it can no longer be theorised that the governing paradigm is implicit and "unamenable to scrutiny" as Peter Hall had first posited of paradigms in general (Hall, 1993 p. 279). Now the "politics of purpose" (Borrás, 2012 p. 429) has rendered it visible and, indeed, politically accessible for deliberate shaping. And though this politics of purpose may have had its origins at the national level with

[96] Prior editions (1998-2021) are available at https://www.oecd-ilibrary.org/industry-and-services/science-technology-and-industry-outlook-1998_sti_outlook-1998-en. See appendix 4 for a summary of the key themes that the OECD chose to highlight in consecutive editions of STI Outlook, both reflecting and perpetuating the construction of a new paradigm.

the growth of investment framing by national governments, emerging drivers now transcend national borders (Bergek et al., 2023; Falling Walls Foundation, 2021; OECD, 2023a).

Will new transboundary considerations and ideas begin to redefine national interests and shift the institutional structures established to serve them? Certainly, domestic contexts and institutional legacies have been shown to condition how new ideas are interpreted and whether they are viewed as legitimate. Equally though, new ideas condition the way existing domestic institutions are perceived, potentially throwing their legitimacy into question. For instance, the New Zealand Labour government appears to have begun to address the issue in its latest attempt at reforming the RSI sector:

> Research institutions in New Zealand have largely remained within the same operational form and design as established in the early 1990s. It is timely to check in on the design and organisation of our institutions to make sure we continue to have sound design principles, and are connected, resilient, adaptable and able to meet the future needs of New Zealand. (MBIE 2021a, p. 3)

An enduring tension is whether the "future needs of New Zealand" (or Denmark, or any other sovereign nation for that matter) can be aligned with shared global needs. The ideational and institutional pressures (and indeed material pressures of economic recovery and seeking access to multilateral RSI funding) to coordinate national knowledge production, to break down disciplinary and other institutional silos, and to direct knowledge application in specific ways, is destabilising the governance paradigm.

Some tentative practical suggestions to help resolve this tension are made in Chapter 11. First though, the closing section of this chapter considers another methodological contribution suggested by this thesis – the concept of small country RSI as a study model.

10.2 What *Can* We Learn From Studying Small Countries?

A second underpinning assumption at the outset of this thesis was that there was something to be learned from analysing small country public research systems. Methodologically, the choice to focus on small countries was justified on the basis that it allows for the kind of detailed chronology that can reveal the multiple interacting factors at work in the establishment or destabilisation of governance paradigms at the heart of public research system evolution. But it is timely now to return to the initial assumption to assess whether the approach indeed offers broader insights that could – at the very least – prompt reflection in larger systems.

In other words, can we consider small developed RSI systems as bellwethers (Skilling, 2020; Veenendaal & Corbett, 2015)? As discussed below, this thesis illustrates at least two reasons to believe we can. First small systems offer a way to test the strength of observations, and perhaps their potential for generalisability. Second, they can reveal phenomena that would be worth investigating across different systems, but that might go unnoticed in larger contexts with greater resource buffers.

Testing the observed against the expected

Features of small countries found in the literature offer a way to test the strength of observations made in this thesis about RSI governance dynamics. Specifically, if a certain behaviour is expected, owing to the small size of the public research system, but instead a seemingly contradictory behaviour is observed, one inference is that the factors driving the observed behaviours are sufficiently influential as to cause deviation from the expected path. For instance, consideration of the key observations made in the case studies against the small

state literature's concepts of 'shelter-seeking' and 'status-seeking' seems to be affirming in this way (Thorhallsson et al., 2018).[97]

The first concept posits that, in addition to seeking military and economic shelter to reduce exposure to global risk, small countries also seek 'societal shelter' to help them avoid isolation and protect against "cultural, educational and technological stagnation" (Thorhallsson et al., 2018). Societal shelter "gives access to networks where innovations and academic practices can be shared, where scholars and students can access information that is often not available in the small state," thereby generating the societal resources to more nimbly and adeptly respond to so-called soft challenges (Thorhallsson, 2018). Meanwhile the concept of 'status-seeking' suggests that small countries seek to be perceived as influential global actors with a specific role to play in the world (Wohlforth et al., 2018). Examples of status-seeking include The Netherlands' production of international law and Norway's status as an international good global citizen. It is thought that niche offerings provide leverage for small-states to have some influence (Neumann & Carvalho, 2015).

Whether or not these small state strategies appear in specific policy sectors in small countries is not directly addressed in the literature, but it is reasonable to assume that they would pervade policy thinking generally in small country contexts – and perhaps especially in RSI. Therefore, we might expect to see a kind of societal shelter-seeking and status seeking among the public research policy strategies in the small country case studies considered here.

[97] Scholars of small-state theory in International Relations historically have focused on states' economic and military vulnerability, and therefore their need to seek shelter through alliances with larger states. Recent work that broadens this concept has emerged in the post-Cold War era (though before the Russian invasion of Ukraine) to include 'societal shelter'.

As expected, both phenomena are visible: Denmark's system has both the shelter of the European Research Area and an established status in knowledge-based industries (pharmaceuticals, green energy). New Zealand, for its part, has taken up some sheltering opportunities (e.g., the American Fulbright research exchange programme and recent association to the European funding framework program). It has also recently invested considerable policy and financial resources toward building a niche aerospace sector, for instance.

At the same time however, the case chronologies clearly demonstrate contestation and paradigmatic fluctuation in successive attempts to articulate and give effect to a shared understanding of the purpose public research system in the national context. There are enduring and intensifying debates, for instance, about national priority-setting, about favouring public or private outputs, and about whether to incentivise competition or collaboration.

The fact that such contestation and paradigm instability persist in contexts where shelter-seeking and status-seeking behaviour would be expected to create a more unified and externally responsive perspective, therefore seems to affirm the significance of the study's main assertions and key observations: The underpinning governance paradigm is (now) perpetually unstable; Domestic pressures supersede external ones in constructing a shared understanding of the purpose of public research and in justifying public investment; And where external pressures are considered, they are interpreted and made sense of through domestic (ideological, institutional and material/economic) lenses.

In the same way that the expectation of societal shelter seeking and status seeking can help test observations about RSI and arguably affirm their significance, another expected behaviour is also telling. As discussed in the introduction, the literature points to a tendency in small country research systems to conflate technology and innovation policy with public research policy, thereby presupposing that the purpose of public research is commercialisable innovation (Glod et al., 2009). Thus, when an apparent unbundling of these purposes does occur (e.g., in the reorganisation and renaming of ministerial portfolios or refining funding criteria to reflect greater diversity in types of impact), it can be inferred that this is done with conscious effort by government. Such action therefore suggests the *political nature* of the research governance paradigm as, indeed, such changes tracked closely with changes in government. It is the small country context of public research systems that has helped not only to reveal, but potentially also to affirm these observations by providing a ready test of the relative influence of the forces observed.

Revealing what might remain hidden in larger contexts

A second reason that small, developed RSI systems seem to be useful models for analysis lies in their increased sensitivity to context. As such, they may help to reveal phenomena that would go unnoticed or take longer to appear in larger systems with greater resource buffers. Thus, observing what happens in smaller systems might generate hypotheses and suggest new lines of inquiry worth testing in larger and more diverse research systems.

The following are two such examples from the cases studies. Unlike the main observations of this thesis presented in Chapter 9, these examples are more directly related to small size. Their utility here is simply to suggest, rather than test, emerging ideas about the

dynamics of public research governance. The first example concerns the role of self-perception in the construction of the public research governance paradigm. The second one relates to the apparent conflation of 'national', 'corporate' and 'public' interests in research governance discourse and practice.

The role of self-perception in structuring research governance and policy decisions

As discussed in the introduction to this thesis, small state scholarship has pointed out that 'small,' can be defined in different ways. Material (population, territory, economic) and security lenses are often used to define small countries with reference to their vulnerabilities and disadvantages, however a so-called perceptual lens can also be applied (Brady & Thorhallsson, 2021; Thorhallsson, 2006). A perceptual definition treats 'small' as a political construct that is decoupled from material definitional constraints (Baldacchino & Wivel, 2020). In this way, perceptions about what it means to be a small country – and more specifically self-perceptions held by decision-makers – can be analysed as both interpretive filters and as strategic frames used for political purposes. Indeed, the role of self-perception has long been part of the small state literature generally (Thorhallsson, 2006), and some scholarship has pointed to its application within the research and innovation policy specifically (Browning, 2006). However, there has been little critical attention paid to its interpretive and political role in *framing the purpose* of public research, and therefore shaping the RSI governance regime.

The case studies of both Denmark and New Zealand both suggest that self-perceptions related to small size played a role in these public research governance dynamics. The perception of small served as an interpretive filter through which RSI policy-makers made sense of and responded to their contexts. On one hand, being small justified limited

investment and forced budget prioritisation: “We can’t do everything and must make choices” was a popular theme, expressed in different ways by policymakers in New Zealand where the overall investment remained below the global benchmark of 3% GDP.

On the other hand, ‘small’ was at times equated to ‘nimble’ and used to justify taking risks in new domains of research: “We can be nimble. Our knowledge and know-how can span sectors more easily” (Key Informant Interview, ministry official New Zealand) exemplifies common responses to probe questions about New Zealand’s investment in space sector research, which drew in part from yacht racing to develop mini satellite launch technology. That it could be used in seemingly opposite ways, demonstrates how self-perception can be a flexible political tool.

In Denmark, key informant interviews also related the self-perception of ‘small’ to the country’s maritime culture and equated it to “resourcefulness” and “necessary openness” (Key Informant Interview, Innovation Policy Council Denmark). Denmark has translated this self-perception into a reputation within Europe for innovation and international connectedness. For instance, this self-perception is what drove Denmark’s famous Internationalisation Strategy for the public research sector in the early 2000s.

Thus, depending on who controls the ideational discourse, the material reality of small size can be interpreted in different ways, leading to different policy decisions. The interpretation can be either pessimistic or optimistic, and strategically deployed by actors seeking to support their particular arguments.

It is a matter for future investigation as to whether self-perception about small size may be an interesting window on the role of self-perception as a factor in public research

governance more generally. That is, is size the only reason that self-perception matters? Could linguistic, cultural, or economic profile or historic ties also shape self-perception and, in turn affect government's interpretation of the purpose of public research and therefore how it is governed? The Danish and New Zealand case studies can only hint at the importance of self-perception in shaping the public research system. Any claims or further extrapolation would need to be tested with broader analysis through carefully designed comparative studies.

The observation nonetheless raises the question of who defines self-perception and thus the particular interpretation of strengths, deficits, values and interests that are addressed through the public research system. The existence and impact of this kind of definitional power is also revealed in an observation about small states' ambiguous discourse on national and public interests, outlined in the next section.

The discursive ambiguity of national interests and public interests in the RSI sector

The case studies have demonstrated that interpretations of 'national interest' are often conflated with the 'public interest.' Furthermore, 'national interest' and 'corporate' or 'private' interests tend to converge within a de facto economic-growth framing of RSI, leaving little apparent room for truly public interests. In New Zealand, for instance, significant agricultural advocacy, and the fact that the country's largest dairy exporter is farmer-owned tends to blur the distinctions. Indeed, advertising campaigns such as "The whole country does well when the country does well"[98] leverages this ideational conflation.

[98] New Zealand Rabobank advertisement from 2021

Yet the terms are not synonymous of course: Public interest encompasses the protection of citizen wellbeing and collectively held resources. National interest places government decisions in global context by definition, and therefore considers national security concerns and the economic competitiveness of the state. Corporate or private interests refer to individual enterprises. Although these private sector interests can and do serve national interests through tax revenue and job creation, they are not specifically aimed at this purpose..

Not only are these concepts not synonymous, but they can also be in tension. As the case studies have shown, both the underlying conflation and the emerging tensions are rendered more visible by the small country context generally.

First, because trade and security options are limited in small countries, public interests tend to be subsumed into national interests, often with support – or unexamined acceptance – by the public. Another potential factor that scholars of small countries have pointed out – but which is admittedly untested in this thesis – is the relative socio-culturally cohesion which could reduce the likelihood of serious public opposition to the national agenda when viewed in the broad geopolitical and economic context (Campbell & Hall, 2009). So, when dissonance does occur – for instance when a supposedly 'nationally important' industry is perceived or shown to have negative environmental or public health impacts – the reverberations might be all the more destabilising, making obvious both the conflation of interests and their conflicting positions.

This phenomenon can be seen even more clearly in the public research sector given its dual imperatives to generate knowledge that can serve both the economic growth agenda

and the public interest agenda. In small systems where resource constraints tend to force prioritisation, support for one imperative can come at the expense of the other. This is particularly so where small country policy-makers perceive that all but the most context-specific public-interest knowledge should be generated (and thus paid for) by research systems of larger countries. Meanwhile, research aimed at domestic innovation with the potential for commercialisation and economic growth through private sector appropriation is seen as a primary aim (Key Informant Interview, ministry official, New Zealand).

The literature does point to the proximate observation that technology and *policy* for innovation and for research tends to be conflated in small countries (Asikainen, 2016; Glod et al., 2009). However, to understand the conflation in terms of types of *interests* rather than simply types of *policy* would help to expand the analytical frame and expose tensions. For instance, it is one thing to prioritise industrial innovation research on the basis that the public will benefit if the economy grows and diversifies, but it is quite another to structurally prioritise (or limit) certain public interest knowledge production according to perceived national economic interests. The former focuses on the conflation of types of policy while the latter focuses on the conflation of interests and its impact.

This observation, arguably made obvious by the small countries context, would need to be tested in larger and more diversified research systems. Do governments' RSI paradigms tend to conflate national and public interests by default? If so, what conditions create an apparent alignment of interests or, conversely, what is it that creates or reveals tensions between interests?

Some related questions might be: Are countries with economies anchored in extraction or high emissions-producing industries more likely to experience contestation and tension between research aims purported to be in the national interest and those in the public interest? As well, do Right-leaning governments seek to align perceptions of national and public interests in RSI while Left-leaning governments expressly treat them separately? In New Zealand for instance, the Right-leaning government changed the funding criteria for so-called investigator-led research, requiring that it demonstrate its benefit to New Zealand. The subsequent Left leaning-government subtly shifted this requirement to benefit "New Zealanders." The distinction may appear semantic, but it reflects the classic preoccupations of economic growth and societal wellbeing, which are generally linked to the Right and Left sides of the political spectrum respectively. The implications for the type of research produced (or systematically not produced) are material.

How are such tensions between public interest research and national interest research navigated within policy and governance decisions in practice, if they are recognised at all? In Denmark, the conflation of national and public interests seems barely noticeable, perhaps because of the institutional role of the European-level funding, which provides an accessible counterweight to the government's focus on research in the national (economic or geopolitical) interest.[99] In the New Zealand, in the absence of a supra-national institutional counterweight, the apparent tension between supposed national and public interests has

[99] Professor Matthias Kaiser, University of Bergen Centre for the Study of Sciences and Humanities. Personal Communication 2022

played out in a more pronounced way within the public research system, depending on the politics of the government in power.

These are just some of the questions that could be tested in more diverse comparative RSI system contexts. The answers could by help reveal the impact of assumptions (whether unexamined or strategic) about what constitutes research in the public interest. The preceding discussion and examples from the case studies suggest that small country models can indeed help to provide “answers to larger questions” (Veenendaal & Corbett, 2015).

Chapter 11 Conclusion: Prospects for the "Next Social Contract"

> The first generation [social contract] attempted to remove science from societal (political) control, delegate the governance of science to the scientists and to focus on basic research. The linear model was a theory to explain that this would drive not only scientific but also socio-economic progress.
>
> In the second generation, society took back some control of research, funding more applied research and innovation to make a more direct connection to innovation and growth [and encouraging] interaction between research and research users.
>
> The third generation focuses on societal challenges (some of them caused by the very growth that had been promoted in the first and second generations) and rests on the rapidly growing body of research and emerging theory on socio-technical transitions.
>
> (Arnold and Barker 2022, p. 61)

As the global context for knowledge and technology becomes more focused on the collective global issues of our time, a third-generation 'transformation paradigm' for RSI governance is emerging within multi-lateral science policy discourse (European Commission, 2021; OECD, 2020, 2023a). For instance, the OECD, now asserts that it is no longer enough to rely on the conventional configuration of research, governments and markets, that have been structured to deliver the liberal ideal of knowledge for innovation and economic growth (OECD, 2023a). Instead, proponents of an emerging paradigm call for explicit collective action toward global public interest objectives. Ideationally, this emerging interpretation goes beyond societal *challenges* to aim instead for transformation of socio-technical *systems* (e.g. transportation, food, energy, etc). Institutionally, it positions RSI as a *central mechanism* of that transformation, broadening the range of actors from government, industry and academe, to include civil society and other stakeholders in a non-linear and iterative way (Benner, Serger, and Marklund 2022, p.13). It encourages new forms of transdisciplinary knowledge

production, which blur the boundaries between knowledge producers and users, and disrupts the very foundations of how expertise is legitimised.[100]

11.1 Case study observations and the emerging paradigm

This emerging boundary-spanning remit for RSI may well be making "the anachronistic war between first- and second-generation governance factions irrelevant" (Arnold and Barker 2022, p.83), but it is also intensifying the underlying political nature of the public research sector, which was observed in the case studies (chapter 9). Indeed, the case studies showed that there is little paradigmatic stability in RSI governance due to the relative lack of shared perspective on the purpose of public research. Instead, the framing of public spending on RSI as a value-generating investment gave successive governments justification to shape their investments according to their own definitions of the public impact they sought from knowledge production.

Thus, funding objectives and organisational arrangements experienced governance swings; Left-leaning governments tended to seek impact to explicitly inform their broader public policy goals, while right-leaning governments tended to focus on the innovation and commercial potential of the RSI sector, often taking for granted that what government perceived to be in the national interest was also in the public interest. The small size of case study countries helped to show that this implicit alignment of interests seemed unproblematic until rapidly changing conditions, such as climate and ecosystem breakdown,

[100] Structures to accommodate such transdisciplinarity are only just emerging and taking shape in conventional western universities, with all the attendant challenges they bring to entrenched institutions such as peer review and performance review for non-standard academic work (Akerlof et al., 2020; P. Gluckman & Kaiser, 2023; Larrue, 2021; OECD, 2020; Simon et al., 2019).

began to draw attention to where successive governments were (and were not) prioritising their RSI investment. Moreover, from at least 2015 onwards, multi-lateral pressure for RSI to contribute to collective action on global challenges intensified these political dynamics by introducing global ideational and material pressures on national RSI regimes for which the underlying governance paradigm was already unstable.

These observations from the case studies suggest the challenges that lie ahead for proponents – especially in the multilateral community - seeking to prompt a more purposeful and deliberate paradigm shift that would position national RSI in support of socio-technical transformation at national and global scales. But the case studies also offer clues about how such change might come about.

Specifically, they suggest three high-level and interrelated interventions that could support national public research systems in addressing third-generation problems by resolving the multi-level mismatch between countries' second-generation ideas and institutions and third-generation discursive and material pressure from the global level.

Such interventions would correspond to the identifying characteristics of governance paradigms that formed the methodological basis of this thesis (see table 5, p.85):

1. Framing a new shared understanding of the *policy rationale* behind public research by strategically harnessing the notion of 'investment,' which emerged as a significant factor in the case studies.
2. Updating the *operational arrangements* which not only reflect the current underlying rationale, but also serve to reinforce it, as the case studies illustrate.
3. Creating new strategic *roles and actors* as intermediaries to broker and coordinate both horizontally (across policy and industrial sectors) and vertically (across levels of governance) to purposefully establish a third-generation governance paradigm.

Derived from the case study observations and insights from the literature about the processes of paradigm construction and institutionalisation (see Table 4, this thesis), these interventions are detailed in the three final sections that follow.

11.2 Harnessing the Power of Investment Framing

The case studies have demonstrated both the ideational power and the material impact of 'investment' as a discursive frame for the rationale of support public research (see section 9.3 in this thesis). For New Zealand, Denmark and multi-lateral norm-setters like the OECD and the EU, interpreting the rationale of public research funding as a value-forming investment within the system of national accounting ushered in second-generation governance. This interpretation supported governments taking greater control of the RSI agenda and steering it more purposefully toward societal priorities – at least how these were perceived and defined by the government-of-the-day. But while the investment rationale justified greater government spending in the sector, which research communities welcomed, it also justified governments' right to shape their investment portfolio by prioritising some types of research over others.

Thus, any increased funding did not necessarily stabilise the RSI sector because it came with more activist governments and their shifting priorities on both sides of the political spectrum. Indeed, with the investment rationale, the focus of the sector has tended to oscillate between an emphasis on industrial innovation for economic competitiveness and societal challenges (now 'transformations'), depending on the government of the day. To be sure, industrially-focused RSI policy rationales have recently started to introduce some directionality, specifying technologies to develop in support of societal transformations toward climate and digital resilience for instance. But finding ways for this work to be led by

societal values rather than technology-driven interests remains a policy challenge, as the Danish government's attempt to guide innovation clearly demonstrated.

A new rationale or reframing the current one?

Recognising this vulnerability to the shifting political priorities and interpretations of successive governments, but also understanding the power of a mobilising concept, some international pressure groups have argued that more attention should be paid to a rights-based rationale for public research rather than an investment rationale. For instance, the American Association for the Advancement of Science has called on UN member states to give greater effect to Article 15 of the International Covenant on Economic, Social and Cultural Rights which was adopted by the UN General Assembly in 1966 and came into force in 1976, administered by the Office of the UN High Commissioner for Human Rights (AAAS, n.d.; International Covenant on Economic, Social and Cultural Rights, 1976). This rights-based rationale requires UN member states to: 1) recognise the right of everyone to enjoy the benefits of scientific progress and its applications; 2) conserve, develop, and diffuse science; 3) respect the freedom indispensable for scientific research, and 4) recognise the benefits of international contacts and co-operation in the scientific field.

It is perhaps unsurprising that scientist-led bodies like the AAAS advocate for greater adherence to Article 15, which would help ensure the stability of the RSI sector. However, interests of the scientific community aside, this renewed call for the human right-to-science has resurfaced at a time of high-profile debate about the use (and non-use) of science-based evidence in public policy formulation, especially on climate and environmental issues in major extraction-based economies internationally. The renewed emphasis is intended to reinforce the duty of governments to support public research on the basis that the knowledge produced

would in turn support better public policies. Yet, without agreed and codified structures for implementation and compliance at an international level, the right-to-science as a policy rationale remains largely aspirational. For this reason, as a counterpoint to investment framing, the right-to-science concept actually serves to confirm the power of an investment approach to RSI, while also demonstrating its lack of alignment with the 'transformation' agenda.

For advocates who want to mobilise RSI for broader transformative purposes, therefore, the answer may not be to reframe the idea of investment, but to harness it while reframing instead what is considered a valuable return on investment (ROI) in public resesarch. Almost certainly, ROI would still include appropriable innovation, particularly technologies aimed at emissions reduction and at the socio-technical transformations to support it. However, reframing it could also include ways to fulfil citizens' rights to public-interest knowledge for decision-making.

After a generation of market-oriented RSI policy-making and governance however, structural and ideational path-dependency at the national level have been shown to make it difficult for governments to perceive new forms of value (Bergek et al., 2023). A broader interpretation of the concept of innovation might change this, with. social innovation, not as a fringe activity, but as a central goal, alongside more purposeful industrial innovation aimed specifically at clean technologies and at facilitating regenerative and circular industrial practices.

In the immediate pre-pandemic period, such an interpretation was gaining traction with some science and innovation policy scholars and advocates under the banner of

transformative innovation (Borrás, 2020; Borrás & Schwaag Serger, 2022; Diercks et al., 2019; Schot & Steinmueller, 2018; Weber & Rohracher, 2012). During the pandemic, the collective action and alignment of public and private interests in RSI seemed to accelerate the uptake of this transformative thinking by governments – at least for a time. The OECD gave the concept added platform by questioning the foundations of its own conventional innovation wisdom, later reprising and deepening this line of thinking in its 2023 edition of STI Outlook, the first of the post-pandemic era:

> STI (science, technology and innovation) policies have traditionally been implemented in response to a number of "failures" that affect research and innovation ecosystems, and that may result in weaker innovation performance than would be desirable from a societal perspective. The shock of COVID-19 has drawn greater attention to other emerging crises, notably the risks of climate change, and demonstrated that more needs to be done than just supporting business conditions and addressing market failures. (McGuire & Paunov, 2022)

Are these emerging interpretations (even with new accounting methodologies) likely to change entrenched perceptions of research and innovation as generating strictly financial return on investment? As the case studies have shown, the ideational (policy rationale) component is only one part of the RSI paradigm. On its own, it is insufficient for institutionalisation without structural change to how RSI is organised and governed, as discussed in the next section.

11.3 From Organisational Path Dependency to Purposeful Organisational Design

As the general chronological overview and case study chronologies demonstrate, the very concept of a national science and innovation system began to formalise with the multi-level promulgation of specific ideas about the purpose of public research for economic growth and

national competitiveness. In this context, national RSI policy portfolios became increasingly organised through Ministries of Industry in various guises (i.e., ministries or departments of innovation, enterprise, business, etc).

Such organisational arrangements have been reinforced institutionally by the fact that Science and Research are often packaged as a single item within national budget and appropriations processes. Responsibility for this budget is often vested conveniently within a single ministry, rather than in a more distributed structure across other knowledge-using policy sectors in government. Some countries, such as New Zealand do distinguish structurally between 'science and innovation' and 'higher education' portfolios, and coordinate between these with boundary-spanning councils or agencies. But if more directional and socially transformative knowledge production is sought, this distinction alone would seem unlikely to affect the path-dependency within industry ministries' mandates and structures.

Even where RSI is a sub-portfolio having more autonomy with its own minister or secretary within a larger industrial policy portfolio, the scope of influence is usually bounded by ministerial or departmental budgets. This makes it difficult to apply funding across sectors in the novel and transformative ways that advocates call for. It also means that other sectors have little influence on RSI direction-setting despite recent calls in the multilateral community for consensus and coordination across multiple sectoral perspectives

Moreover, as the case studies have demonstrated, both sides of the political spectrum grant themselves license to shape RSI in their own image, meaning that power to change the definition of the return on investment is doubly constrained. It is constrained institutionally by the budget-holding ministry's mandate, and it is constrained ideationally (politically) by the goals of the government of the day. These issues highlight the path-dependent structures that serve to reinforce the current paradigm at the national level.

The implications of maintaining the current way of organising RSI may now be reaching beyond these structural constraints within national systems. Some scholars have drawn attention to the international stakes of RSI's new politically central role. They suggest that European RSI discourse, for instance, has moved beyond just infusing the sector with broader policy goals. It now influences state-craft more generally as countries must position themselves in a carbon-reducing, pandemic-ready, socially-inclusive and digitalised world order (Wilsdon & de Rijcke, 2019). This is the new context in which states are seen as either leaders or laggards depending on their public research science and innovation strategies.

What could third generation structures look like?

The governance regime of a truly third-generation paradigm would likely need to lift governance of the public research portfolio out of singular (usually economic development) ministries, and (re)introduce dedicated ministerial portfolios for science and research. In addition, broader consensus-based governance and coordination mechanisms could help attenuate any disruptive vacillations between government-of-the-day priorities at the national level.

Of course, first-generation research governance did exactly this with early National Research Council/Institutes models. However, the decision-making authority in these earlier models tended to be limited to elite researchers and members-only scientific bodies. By contrast, third-generation boundary-spanning governance and coordination mechanisms might also include the perspectives of industry, civil society and other relevant partners[101] to

[101] For instance, in settler states, co-governing indigenous nations would have a role.

enable both horizontal (across policy sectors) and vertical (across levels of governance) coordination of research policy and funding.

Institutionalising such a mechanism could enable it to survive successive governments, fostering the longevity to match the time horizon of research and technology development for socio-technical transformations. Non-partisan legislative protection might ensure a mechanism for national deliberation and direction-setting as well as coordination across multi-disciplinary RSI actors and stakeholders, including both industrial and pluralistic citizen input.

Some countries have longstanding science and technology advisory councils serving heads of government, which appear to meet these design principles. However, while they may reach the executive of government directly, they are also often elite and technocratic by design. A more inclusive structure might thus be informed by multiple perspectives and serve as an intermediary for collaborative goal-setting and prioritisation of national research agendas through a broadened slate of system actors.

Some countries may be institutionally primed for such a restructuring of their RSI governance mechanism, which could allow them to respond more easily to the third-generation purposes and directionality practices of public research. Other countries might find it difficult to overcome structural path dependencies or partisan perspectives. Denmark and New Zealand have provided illustrative examples, as the former is already accustomed to consensus and coordination, while the latter has an adversarial parliamentary system and liberal market economy founded on competition.

Organisational design can both exploit the benefits of such structuring institutional elements and attenuate their constraints. The difference lies in actors' awareness of implicit structural challenges and the potential levers available for more intentional and consensus-

based change in RSI organisation and governance. The next section draws from the case studies to show how specific roles in domestic RSI systems could foster an intentional shift toward new global norms about shared knowledge needs.

11.4 Boundary-Spanning Roles for Intentional Shaping of New Norms

From the late 1990s, political science and policy scholarship began to develop a sense of the systemic variation that mediated the spread and uptake of international ideas and norms into the domestic policy arena (Checkel, 1997). A generation of comparative and constructivist research has contributed to understanding both the challenges and the mechanisms by which norms are shared trans-nationally and socialised domestically, showing how new ideas take root. The concept of norm entrepreneurs thus emerged to account for the "ability of non-traditional international actors to mobilize information strategically to help create new issues and categories" in an effort to persuade governments of the importance of issues and build international consensus on strategic directions (Keck & Sikkink, 2014 p. 89). Significantly, norm entrepreneurs do not seek to influence policy outcomes directly, but instead try to change the terms and nature of the debate. These are the skills and insights of strategic actors who could reframe what is understood by return on investment in RSI. They could set the groundwork for "ideational brokerage" (Schrad, 2010) and nudge more purposefully the structuring institutional settings toward third generation RSI systems at the national level.

As the case studies demonstrated, at various times and in various configurations, ideational, institutional, and material factors set the conditions of legitimacy for policy and

governance ideas to become established. Looking across the case chronologies, the impact of strategic actors comes into focus. Examples include: institutionalising non-academic actors on university governance boards; strategically establishing (or disestablishing) advisory bodies; seeking external validation of ideas by domestically-respected international actors. The list is long, but in each case, a well-placed agent strategically exploited or circumvented institutional inertia to prepare the ground for change to occur. Yet many of the key changes that happened were also shown to be partisan and subject to overturning by incoming governments, keen to make their investment work *for them.*

This type of power asymmetry, seen at various times throughout the case studies (e.g., populating a governance committee in favour of a particular perception), may have contributed to ongoing volatility of the sector, yet it was also shown that strategically placed agents and trusted brokers can be systemic resources to enact change. Thus, trusted brokers would be especially important if, as proponents argue, societal transformation requires the alignment of ideas, material interests and institutional changes across governments, firms, markets, and citizens.

In this regard, the evolution of interest and advice of the OECD is telling. In the aftermath of the Covid-19 pandemic, the OECD began to explore systematically member states' civil society engagement practices for new forms of RSI governance, (McGuire & Paunov, 2022; OECD, 2023a), apparently recognising the importance of trusted relationships to support more intentional shaping of norms, interests and eventually, the institutions that both reflect and reproduce these.

Examples from the case studies

In the context just described examples from the case studies hold both promise and lessons for proponents of a transformative agenda for RSI. For instance, New Zealand's introduction of a Chief Science Advisor (CSA) in 2009 was an unprecedented role designed to bring the views of the public research community closer to the halls of government, not as an advocate but as a conduit and coordinator. At the same time however, the simultaneous adoption of the investment rationale by the right-leaning government had encouraged an active minister. This situation left little room for the CSA to shape research funding discourse. Instead, as a norm entrepreneur, the CSA developed new vertical linkages to the global science policy community (international and multi-lateral), while also seeking to coordinate horizontally under the broad aim of developing a culture of evidence-informed public policy in New Zealand (P. Gluckman, 2013)

However, while the establishment of this role seemed exemplary of third-generation governance, it met with second generation institutional and organisational barriers domestically, as government had moved the public research and science portfolio into the Ministry of Business and Innovation. This arrangement appeared to inhibit deliberate collaboration and resource sharing across ministerial portfolios, making it difficult to routinely shine the light of evidence on the interdependent factors driving complex policy problems.[102] In this way, the transformative work of changing the "terms and nature of the debate" (Keck

[102] Except where scientist-led multi-disciplinary and multi-sectoral collaborative teams were successful in gaining funding from the contestable (research granting) system.

& Sikkink, 2014), which can help open up productive space to reframe complex problems with new forms of knowledge production, was a strategy that was largely unavailable at the time.

It was not until the CSA established a forum of ministerial science advisors (who were also seconded from full-time research positions), that an intersectoral and interdisciplinary lens began to develop. In the years since their establishment, these roles have diversified and become institutionalised. As norm entrepreneurs, they have become a key point of contact inter-ministerially as well as internationally (Key Informant Interview, Ministry official New Zealand). Moreover, they are in a strategic position to perform the dual task of defending robust and evidence-based practices, while also introducing or broadening discursive concepts that can disrupt ideational lock-in, which underpins and perpetuates institutional path-dependency.

The successor CSA, for instance, supported some of the initial research and policy discussion on decolonising the RSI system in the context of the subsequent Labour government's governance reforms led under the Treaty of Waitangi/Tiriti O Waitangi. But while the CSA and portfolio-based equivalents are now well positioned to help frame policy issues for a systemic response in an iterative and evidence informed way, they remain limited when it comes to shaping how knowledge producers can respond. That is because governing the RSI portfolio primarily from a ministry that is institutionally and organisationally structured to prioritise innovation and economic growth is compelled to favour those outcomes.

Here, the case of Denmark provides an instructive counterpoint. Independent of its multi-level governance context within the European Union, Denmark’s sovereign choice to

bundle the governance of its public research portfolio with its higher education portfolio set the conditions for different kinds of norm entrepreneurs to have impact on RSI policy and governance choices. A home-grown epistemic community of science policy scholars, with ties to European-level policy expertise and scholarship, was brought together within the Research Policy Advisory Council. This council was later expanded to including innovation policy as well. When the established and well-respected secretariat for this arm's length council was brought into the ministry, it had already earned the respect (and ear) of the academic community and of the government. To this was added the respect of industry representatives also.

Although the relationship with industry seemed to have some false starts, as outlined in the Danish case study, the 2019 review of the Danish RSI system by European Commission science policy advisors (themselves norm entrepreneurs) catalysed efforts to better coordinate with industry, including industrial philanthropic foundations. It remains to be seen whether a closer and more trusting relationship will pave the way for a governance approach that dares to be as purposeful and directive with innovation policy as it has been with public science and research, instead of relying on market forces alone. If so, the shift to a new transformative innovation paradigm may indeed eventuate (Bergek et al., 2023; Borrás et al., 2023; Diercks et al., 2019).

As the suggestions and examples in this chapter demonstrate, however, a governance paradigm does not change itself. As actors respond to and make sense of material, institutional and ideational pressures, they may be reinforcing or destabilising the current governance conditions. Making these processes more explicit increases their potential as points of intervention where deliberate and thoughtful paradigm change is sought by advocates of 3rd generation RSI governance.

11.5 Concluding Thoughts on a Research Agenda

As with most research projects, this exploratory study of the construction, institutionalisation and destabilisation of the underpinning interpretive frameworks in public research governance has pointed to adjacent and subordinate lines of enquiry that could deepen or compliment this preliminary work. Therefore, this final section briefly reviews the methodological, theoretical and empirical questions that emerged, but that were left unaddressed within the limited scope of the thesis.

Methodologically, this small-N qualitative study made observations that could only suggest the presence of patterns but could not confirm them. To validate these observations would require an expanded mix of cases to trace their processes of institutionalisation and destabilisation using the same analytical treatment employed here. Moreover, the deliberate inclusion of small and large countries in an expanded dataset of comparative cases could help determine whether small country public research systems are indeed a methodologically robust proxy model and therefore a "canary in a coalmine" for policy recommendations as some have argued (Skilling, 2020). Thus, while the small states literature has treated country size as a variable of interest, a larger comparative study might reveal whether small size can indeed be the basis for a simplified but representative model, as has been discussed in Chapter 10 of this thesis.

In addition to the methodological advances that could be made by building on this study, there are suggestions of conceptual and theoretical paths to follow as well. For instance, the thesis has revealed the significant network of international non-state actors in public RSI policy who are institutional norm entrepreneurs at the global level. These include the OECD, the Belmont Forum, the International Science Council (as well as some of its bigger

member National Academies), the Global Research Council, the European Research Area and others. In developing the concept of norm entrepreneurs, further research might ask to what extent and by what methods have these norm entrepreneurs' own interpretive frameworks about the social purpose of research changed over the years? How has their paradigmatic trajectory co-evolved with that of national RSI systems? Are they more or less influential on research policy today as was, for instance, the OECD in the 1960s?

Other related conceptual ideas that could usefully be pursued include exploring whether RSI governance is indeed becoming more globalist in perspective. Further research could help determine the conditions that might make some national systems more globally collaborative while others maintain (or intensify) a nationalist policy rationale. Are different perspectives paradigmatically embedded or only discursively invoked for strategic gain, and to what effect?

In a similar way, another line of enquiry could test the argument of Mats Benner and colleagues that RSI should now be considered a central pillar in a broad necessary societal transformation agenda required to meet our biggest collective challenges. Further research could help determine whether this argument is borne out empirically, and under what conditions. Finally, it bears considering what RSI's apparent role in the societal transformation agenda, and the deliberate acceleration of this governance paradigm, might mean for the established but evolving norms of scientific research practice itself.

These are just a few of the questions that are prompted by the tentative observations made in this thesis. As the social contract for science continues to change – now in more intentional and directed ways – it is useful to reflect on where it originated and the interplay

of material, institutional and ideational factors that shaped it. Deepening our awareness of these dynamics in different contexts and with different actors, can be a useful tool if the emergence of a new transformational research and innovation paradigm is indeed a new and conscious and collective goal.

APPENDICES

Appendix 1: Material and Institutional Contexts of RSI Systems in New Zealand and Denmark

New Zealand

Aotearoa-New Zealand[103] is a small geographically isolated country (approx. 265,000 sq. km) comprising an archipelago of three main islands in the South Pacific Ocean[104]. Ninety percent of NZ's 5,127,40 people live in cities.[105] The population is very ethnically diverse, with nearly one third comprising Indigenous Māori and Pacific Island peoples[106].

Prior to the COVID-19 global pandemic (from March 2020), New Zealand's Gross Domestic Product (PPP) was estimated to be approximately $189,000 or $39,000 per capita. The economic mix is dominated by primary industries (agriculture, forestry, fishing, and mining), manufacturing, construction, tourism and hospitality, and real estate services. The service sector accounted for 66% of GDP in 2020.[107] Economic diversification has been a policy

[103] In 1994 the Judicial Committee of the UK Privy Council ruled that the New Zealand Government is responsible under the Treaty of Waitangi to preserve Te Reo Māori, the indigenous language. As such, since the early 1990s there has been increasing government effort into providing public documents, broadcasting, and education in a Māori language medium. In 2008, the land registry body made official changes to place names. Increasingly the name Aotearoa-New Zealand is seen in both official and colloquial usage.

[104] NZ has two dependencies – the Ross Dependency through the Antarctic Treaty, and the Dependent Territory of Tokelau. In addition, it has two associated states, the Cook Islands and Niue, for which it has fiduciary responsibilities.

[105] See Statistics New Zealand: https://www.stats.govt.nz/topics/population

[106] The 2018 census reported the following population mix: European 64.1%, Māori 16.5%, Chinese 4.9%, Indian 4.7%, Samoan 3.9%, Tongan 1.8%, Cook Islands Māori 1.7%, English 1.5%, Filipino 1.5%, New Zealander 1%, other 13.7%. Thus, nearly a quarter of the population is of Pacific indigenous ancestry. NZ's population growth rate is 1.9% annually, driven largely by migration.

[107] See Statistics New Zealand: https://www.stats.govt.nz/indicators/gross-domestic-product-gdp/

priority since the late 1990s, with successive governments seeding research and innovation investment especially in the high value foods industry, the creative digital sector and more recently in aerospace sector.[108]

New Zealand is known globally for highly cited environmental and natural hazards research, which is not surprising considering its unique and remote geography, and marine and terrestrial ecosystems (Nature Index, 2020). However, almost all accessible rural land is intensively productive, which has had an undeniable impact on these ecosystems (P. Gluckman, 2017). Conservation of remaining undeveloped land is highly linked to the tourism industry and the government maintains a vast network of nature trails and camping huts.

In terms of formal political institutions, New Zealand is officially a bicultural (Māori and European) sovereign state of the British Commonwealth. The country's bicultural history has shaped its political institutions, with both a Westminster style (though unicameral) parliament, and an obligation to uphold the Treaty of Waitangi on behalf of the Crown.[109] Members of parliament are elected for terms of only three years, through a mixed member proportional representation system, which was adopted in 1993 and first put into practice in

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108 Research and innovation policy entrepreneurialism hit an unprecedented pace in 2016, when the RSI portfolio accelerated the development of an Agreement between the Government of New Zealand and the Government of the United States of America on Technology Safeguards Associated with United States Participation in Space Launches from New Zealand https://www.treaties.mfat.govt.nz/search/details/t/3858. The treaty enabled the development of the emerging NZ space sector, most associated with the first Rocket Lab.

[109] Signed in 1840 and enacted in 1965, the Treaty sets out the terms by which Māori were said to have ceded sovereignty to Queen Victoria while retaining territorial rights under a colonially imposed system of tenure. However, the actual terms of the Treaty, not least the concession of land by Māori, remain contested by because there are two different versions of the text. It was originally drafted in English but presented to most Māori Rangatira in a substantively different Maori Language text, which was signed by them. Māori now account for about 16% of the population and their enduring presence and cultural vitality has made New Zealand a leading Pacific Nation and unique in the world.

1996. The MMP system coupled with short parliamentary terms make New Zealand politics a very dynamic arena of contest and negotiation. This political timing contrasts markedly to the natural cadence of scientific research, which requires long periods of stability to generate the knowledge that ultimately can inform policy making. Yet successive governments have sought to shape the research systems in ways that accord to their interpretation of the social value and purpose of public research. The result has been near constant systemic flux to varying degrees.

Significant reforms during the 1980s introduced monetarist policy and structural reforms that rapidly transformed the NZ economy, moving it from dependency on access to the British market to a free-market economy focused on global trade and competitiveness. The delivery of public services was also redesigned, from a welfare state model to a neoliberal framework, which favoured the performance contracts of New Public Management approaches. This included reforms to the public science and research sector.

As a nation that now relies heavily on rules-based international trade, New Zealand is keenly internationalist in its outlook. While the country is party to multiple international treaties and instruments, it is New Zealand's international network of free trade agreements that arguably captures a lot of foreign policy-making attention.[110] New Zealand has been internationally recognised for its government's respect for transparency (Transparency International, 2022)

[110] For instance, New Zealand is a member of Sparteca, APEC, ASEAN, and was among the founders of the original Trans-Pacific Partnership agreement and was the second country to ratify it before the US pulled out. It is now a member of the reformed Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and signed a trade agreement with the European Union in 2022

and enjoys a global reputation as a civic-minded, and highly liveable country.[111] New Zealand's strong – and growing – international reputation is often cited by media and political observers as the key to attracting foreign investment in innovation and R&D as it seeks to transform and rebuild the economy for a post-COVID world (Business NZ, 2022; Robertson, 2021). However, its remote global position and its lack of industrial innovation ecosystem means that it still struggles to retain knowledge-based industries. Many emerging companies might head across the Pacific to the Silicon Valley and other innovation hubs, though there has long been a government-back movement to try to retain them.[112]

Denmark

Denmark is a small European coastal country of just over 42,000 square kilometres and a population of 5.8 million, of which just over 88% is urban. Denmark is considered quite culturally homogenous. Its population mix includes 86% of the population considered 'Danish' and 13% comprising a mix of Polish, Syrian, German, Iraqi, and Romanian and Turkish.[113] Denmark also counts some 56,000 native Greenlanders (Inuit) among its 'Danish' population as Greenland is an autonomous territory within the Danish Realm, under self-rule since 2009.

Prior to the COVID-19 global pandemic (from March 2020), Denmark's Gross Domestic Product (PPP) was estimated to be $336B or $57,804 per capita. The industrial mix that dominates the Danish economy includes global pharmaceutical leaders, marine shipping, precision agriculture and increasingly, renewable energy technology. Economic priorities

[111] See: https://www.oecdbetterlifeindex.org/countries/new-zealand/
[112] See: https://kiwinet.org.nz/
[113] See: Statistics Denmark: https://www.dst.dk/en/Statistik/emner/borgere/befolkning/befolkningstal

across successive governments have included a strong focus on regional development as the impact of urbanisation increases. However, compared to NZ, economic diversification has not had the same explicit policy attention. This may be due to the fact that the Danish economy has longer history of knowledge-based industrial development. Both Denmark and New Zealand share a commitment to a socialised welfare system built on a highly redistributive tax model.

Denmark is known globally for highly cited life sciences and pharmaceutical research consistent with its well-established medical biotech industry dating back to the commercial development of insulin (Nature Index, 2017)[114]. In the last decade, Denmark is also emerging as a global leader in renewable energy technology research and development. Successive Danish governments prioritised R&D investment to this sector while also establishing some of the tightest emissions regulations globally (OECD, 2023b). While Denmark has considerable fossil fuel reserves, about 70% of its electricity needs are met from renewable sources. In particular wind energy meets about 50% of electricity demand, with Denmark a leader in the turbine design and manufacturing sector. Danish innovation in waste and agricultural bi-product (biomass) conversion account for about 2% of electricity production (Energinet, 2018; Ministry of Foreign Affairs, 2023). To build a market for the fruits of this research and development, Denmark established energy efficient building regulations in 2008 and an

[114] Although insulin, later used to treat diabetes, was discovered by the research team of James McLeod, Charles Banting, and Frederic Best at the University of Toronto in 1921, they shared their process and findings freely in 1922 with Danish visiting scientist August Krogh. In addition to nominating the Canadian researchers for the Nobel Prize in 1923, which they won, Krogh went on to establish Denmark's industrial production of insulin, as it had not been patented by Banting and colleagues (Diem et al., 2022)

efficiency incentives scheme for households has been in place since 2012. In December 2020, the Ministry of Higher Education and Science launched *Green Solutions for the Future*, Denmark's first national strategy for investment in 'green' research, innovation, and technology (MHES, 2020).

In terms of governance, like New Zealand, Denmark is a constitutional monarchy and unitary state, which is organised in a decentralised model of central, regional and municipal governments. Social democratic governance was established in 1849 (Parliament of Denmark, 2022). Parliament is unicameral and members serve a 4-year term, elected by proportional representation. The electoral system generally results in stable consensus-style governance, as opposed to other adversarial systems such as in the US. Consequently, national research budgets and priorities have typically been set through multi-party agreement (Key Informant Interview: Danish Research and Innovation Council). After decades of stability in the science and research sector, major structural reforms took place between 2004 and 2007 when universities merged and absorbed most of the public research organisations. Stable funding then resumed, with predictable annual increases until 2015. This was a watershed year that saw annual funding reduced for the first time in the history of the Danish RSI system. It also saw a more direct role for government in the intentional steering of research through the launch and institutionalisation of a formal centralised research prioritisation process (MSIHE, 2013).

A small country, Denmark seems to play an outsized role in the European community, as one of the original founding states in the Union. In the multi-level governance structure of Europe,

the rotational presidency of the Council of the European Union[115] has been in Denmark's hands seven times. Like all members of the Union, Denmark sets its own Higher Education, Research and Innovation policies, but since the 2007 signing of the Lisbon Treaty in the European Union, there has been increasing effort to align goals and values of national science and research policies with the broader benefit to Europe as an economic community. In playing a key role in establishing Europe's premier research funding program, Denmark was arguably also able to project its own national values and interests onto the European system.

[115] This is distinct from, and sits alongside, the European Parliament as co-legislator.

Appendix 2: List of Key Informant Interview Participants

		New Zealand	Denmark
Policy officials	Higher Education	Tertiary Ed Commission*	Danish Agency for institutions and Educational Grants *
	Industry/ Enterprise /Science Ministry CEO or equivalent	Min Business, Innovation and Employment (Science and Innovation sector Departmental Chief Science Advisor	Danish Agency for Science, and Higher Education
	S&T Council Chair / or Chief Advisor or equivalent	Prime Minister's Chief Science Advisor (2009-2018)	Danish Council for Research and Innovation Policy. Chair and Head of Secretariat
Research performers	University sector peak body	Universities New Zealand Key informant academic	Universities Denmark (Key informant academics)
	PRO sector peak body	Science NZ	The association of government research institutions *
Funders	Ministry (funding arm)	Chair of MBIE Science Board,	Danish Agency for Science, Technology and Innovation
	Public funding agencies or councils	Marsden Health Research Council	Danish Council for Independent Research Innovation Fund Denmark The Danish Research Foundation
* Accessed but full interviews were not possible. In these cases, key informant academics with recognised knowledge of the national research governance system in the case country were consulted to supplement the interview data.			

Appendix 3: Case Country Summaries Tracing Processes of Governance Paradigm Construction

KEY: Each type of process was traced by identifying its representations, shown in the key below. These were then listed in the chronology for each country case. The case country summaries show the governing party, representations of each process, and domestic and transnational background factors of relevance to the RSI sector. Election dates are marked bold and an asterisk

Representations of 'destabilising processes	**Representations of 'normalising' processes**	**Representations of 'institutionalising' processes**	**Representations of 'routine application'**
(A) production of evidence not supporting dominant view	**(D)** Re-title and adapt established entities to signal new concepts	**(I)** Strategic planning and policy statements focused on key concepts	**(M)** Standards to assess or validate new information and actors according to key concepts
(B) Establishment of new or parallel bodies	**(E)** Consultation exercises	**(J)** New types of partnerships established, focused on key concepts	**(N)** Key concepts used in broader range of circumstances
(C) Disestablish or defund bodies	**(F)** External guidance and /or validation	**(K)** New organisational structures, bodies focused on key concepts	**(O)** Key concepts used by broader range of actors
	(G) production or use of measurement frameworks emphasising key concepts	**(L)** Changes to established policies or laws to include key concepts	
	(H) Pilot funding for key concepts		
Bold* = election date			
Bold itallic text **=** Paradigm signalling event			

Gov't	Date	Paradigm period	Paradigmatic processes and actors relevant to RSI system in NEW ZEALAND				Background factors relevant to RSI		
			1. Destabilising the paradigm	2. Normalising new ideas	3. Institutional embedding of ideas	4. Routine application of cognitive filters	domestic context	Transnational context	
	1923…	Settler science			**(I)** DSIR established as central research facility for NZ				1923…
N	1960-1972							OECD founded (1961)	1960-1972
L	1972-1975								1972-1975
N	1975-1984							End of British Common Market (1977)	1975-1984
Labour	1984-….								1984-
	1989*…	Competition	***(C) DSIR disestablished (1923-1989)***		***(K) MoRST and FoRST established***				**1989***
	1992…				**(K)** CRIs established				1992
	1994*…			**(H)** Marsden fund established					**1994***
	1996						Proportional rep electoral system starts		1996
	1997…						Leadership change within government		1997
	1999*				**(L)** Universities made eligible FoRST funding				**1999***
Labour led	2000		**(A)** RSNZ Manifesto 1						2000
	2001					**(M)** Marsden renewed			2001
	2002*	accountability		***(G) PBRF funding established***			Commission on GMO		**2002***
				(H) CoREs established					
	2003…				**(J)** NZTE and industrial sector working groups established		Overarching policy: 'Growth & Innovation Framework'		2003
	2005*…								**2005***
	2007			**(F)** OECD invited to do a benchmarking exercise		**(M)** CoRE first renewal			2007
				(G) Vision Matauranga framework		**(M)** PBRF model reviewed, becomes embedded standard			
	2008*		**(A)** RSNZ Manifesto 2			**(M)** CRI model reviewed, becomes embedded		***Global Financial Crisis starts***	**2008***
National led	2009	Competitiveness and prosperity	**(A)** Jordan Report on CRI reform		**(K)** Inaugural CSA appointed experimentally			Italian seismic science advice controversy	2009
	2010				***(G) 1st National Strategy: Igniting Potential - NZ's Science and Innovation***		GFC impact in NZ		2010
	2011*		**(C)** MoRST and FoRST disestablished (1989-2011)		**(K)** New Ministry of Science and Innovation (MSI) and Callaghan Innovation agency		Canterbury earthquake	Fukushima earthquake	**2011***
	2012			(F) New access to international ideas in Small Advanced Economies Initiative (via CSA)			Freshwater controversy. Overarching policy framework: 'Business Growth Agenda'		2012
	2013		**(C)** MSI disestablished (2011-2013)	**(H)** Great NZ Science Project and National Science Challenges introduced	**(I) (J)** New 'super-ministry' of Business, Innovation and Employment (MBIE) est.		Frequent use of 'NZ Inc.' whole of government branding	Science Council Japan code of conduct	2013
	2014*			**(E)** National Strategy consultation	**(L)** Scientist code of for public engagement proposed				**2014***
			(A) NZAS survey on 'silencing science'						
	2015	Paradigmatic tension: Science in society / competitiveness & prosperity	**(A)** NZAS conference theme: Scientists Speaking out		***(I) 2nd National Strategy: National Statement on Science Investment (NSSI)*** **(L)** Education Act change to university governance			***OECD considers S&T spend as 'investment'.*** UN's 2030 agenda and SDGs launch	2015
	2016						Leadership change within government		2016
	2017*			**(G)** KPIs introduced to Marsden to tie it to NSSI **(G)** Environmental Research Roadmap	**(K)** Creation of new Regional Research Institutes		March for Science events (patchy)	March for Science (US)	**2017***
Labour led until 2020, then majority	2018				**(L)** Repeal Education Act Change to University Governance	**(O)** Chief Science Advisor & DSA model renewed. 2nd CSA	Te Arawhiti Office of Māori-Crown relations		2018
	2019	Recovery, defragment, decolonise	***(A) 'Impact of Science' Paper released by new gov.***	**(E)** Research Innovation and Science strategy consultation			***Wellbeing and Higher Living Standards Policy frameworks***		2019
	2020*		**(A)** Report on Tiriti–led Science-Policy for Aotearoa				Pandemic-related restrictions imposed	Pandemic declared	**2020***
	2021			**(E)** Green Paper consultation					2021
	2022							Russian war in Ukraine	2022

gov't	date	paradigm period	Paradigmatic processes and actors relevant to RSI system in DENMARK				Background factors relevant to RSI		
			1. Destabilising the paradigm	2. Normalising new ideas	3. Institutional embedding of ideas	4. Routine application of cognitive filters	domestic context	Transnational context	
	1850...	Foundations and philanthropy			**(K)** First faculty of science established (Copenhagen U)				1850...
Various Left-leaning governments	1914...			**(H)** Carlsberg heir bequeaths mansion through Carslberg Foundation				WW1 begins	1914...
	1921...				**(K)** Bohr establishes Institute for Theoretical Physics				1921...
	1922...						Bohr wins Nobel Prize for Physics		1922...
	1933...						Bohr supports refugee scientists from Germany	(1940) Nazi Germany occupation of Denmark begins	1933...
	1951...	Paradigm paradox: Freedom & instrumentalisation of science					US-Danish Defence Agreement for research in Greenland		1951...
	1954...				**(K)** First Science faculty outside Copenhagen (Aarhus)		Start of welfare policies & investment in Greenland		1954...
	1957...			**(E)** Denmark hosts CERN group, consults to establish collective Euro science lab					1957...
	1961...							OECD established	1961...
	1963...							First Frascati Manual of RSI indicators	1963...
	1968...				**(K)** System of 5 independent discipline-based councils starts				1968...
	1970s ...								1970s ...
Various Right governments	**1982* ...**						First Cons gov't since 1901		**1982* ...**
	1985...	Management and accountability NPM) paradigm		***(H) Industrial PhD scheme established***					1985...
	1991		***(B) Danish National Research Foundation (DNRF) announced (placed outside***						1991
	1992							Maastricht Treaty for European Union signed	1992
Social Democrates (L)	**1993* ...**				**(K)** First Ministry of research established and new accounting system to bulk fund universities		Social Democrates elected	Maastricht Treaty comes into force	**1993* ...**
	1999			**(G)** University performance contracts introduced	**(L)** Legislative change to give IP to universities, not to individuals				1999
	2000			**(D)** Social Dems rename Ministry of Research (1993) to Ministry of IT and Science				EU Lisbon Strategy and European Research Area launched	2000
Venstre (R)	**2001***	Internaitonalisation and competitiveness (structural reform and co-evolution with Euro RSI)	***(B) Government establishes Research Commission, heralding structural reforms***	***(D) Rename Ministry of Research (1993) to Ministry of Technology and Development***					**2001***
	2002			**(E)** Danish Research Council (academically-led) hosts conference to consult on creationing EU Research Council				Danish Presidency of Euro Council. FP6 (European research funding (2002-	2002
	2003				**(L)** Change to Education Act for more external (industry) rep on Uni gov. boards (in effect, 2005)	**(N)** "From insight to invoice" discourse			2003
	2004		**(B)** 'Strategic' and 'Independent' Research Councils (placed outside existing academic-led system)				Prime Minister's trip to China	New DG Research at EC supports creation of Euro Research Council	2004
	2005				**(K)** Launch Danish Globalisation Council				2005
	2006			**(E)** Consultation on University / PRO mergers. Gov't requires parties to decide partnerships	**(I)** Launch Danish Globalisation Strategy				2006
	2007				**(J,K)** PRO/University mergers complete (8/12 Uni's remain; 12/15 PROs merged in Uni's). Justified as "path to int'l impact through EU funding"		ERA Greenpaper introduces 'grand societal challenges'	ERC is launched / FP7 (2007-2014)	2007
	2008						PM Rasmussen China speech: 'green tech.' 'low carbon economy'	Global Financial Crisis starts	2008
	2009			**(G)** completing structural reform: new Uni funding formula			PM Rasmussen leaves Danish politics, leads NATO	Greenland achieves self-rule in Kingdom of DK	2009
	2010						New PM appoints new Science Min	Europe 2020 economic strategy: "smart, sustainable, inclusive growth"	2010

Denmark summary continued…

gov't	date	paradigm period	Paradigmatic processes and actors relevant to RSI system in DENMARK				Background factors relevant to RSI		
			1. Destabilising the paradigm	2. Normalising new ideas	3. Institutional embedding of ideas	4. Routine application of cognitive filters	domestic context	Transnational context	
Social Democrates (L)	**2011***	Smart specialisation (prioritisation) paradigm		***(D) Rename Ministry of Science Tech and Development to Science,***	***(L) Amend Edu Act (2003): engage Min in Uni governance & approval of goals for perf.***		Social Democrates elected: re-intro welfare (wellbeing) policy agenda	Overarching EU strategy: 'Innovation Union 2020 launched	**2011***
	2012			**(F)** First European 'ERA Peer Review' of Danish RSI system	**(I)** National RSI strategy (following ERA review) "Nation of Solutions"	**(M)** New university funding formula and KPIs fully implemented with 'contracts'		Danish Presidency of Council of EU - influenced FP8	2012
	2013			**(E)** Consultation and development of INNO+ and Research2020 'catalogues'	**(K)** New Innovation Fund announced				2013
	2014			**(D)** Ministry renamed again: omits 'innovation'	**(J)** Expand remit of Danish Council for Research & Innovation Policy **(K)** Innovation Fund Denmark launched to support INNO+		PM appoints 2nd new Science Minister	Greenland TRC	2014
Venstre / populist coalition (R)	**2015***	Innovation and efficiency paradigm	***(C) 20% budget cut to sector (first in history) and bigger % goes to Innovation Fund***				Venstre coalition (conservatives / New Perm Sec (CE of min) is former head, competition authority	OECD considers S&T spend as 'investment' . UN's 2030 agenda and SDGs launch. EC launches FP8 "Horizon 2020" .	**2015***
	2016			**(G)** Re-visit Uni funding formula and KPIs (i.e. student employability)	**(J)** Re-insert innovation policy portfolio into the Ministry remit		Government replaces minister of science twice within year	EC launches and 'Open to the World' RSI strategy Brexit vote in UK	2016
	2017							March for Science (US)	2017
	2018			**(F)** 2nd European Commission Peer Review of Danish RSI system requested **(E)** Forum for Research Funding: explore public and private foundation $ collab	**(I)** 2nd National RSI Strategy ('Ready to Seize Opportunities') and Research2025 Catalogue released. Heralds more collab with private philanthropy.				2018
Social Democrates (L)	**2019***				**(J)** Pioneer Centres launched (May). Groundbreaking collab with private foundations		New Minister appoints special advisor. New Perm Sec after EC peer review	EC (ERA) starts work on next research framework funding program	**2019***
	2020	Recovery and Transitions			**(J,K)** Danish Agency of Higher Education and Science (combines bodies for STI and HE		Denmark among 1st to impose social restrictions	***Pandemic declared / Horizon Europe discussions on hold, repurpose $ to Covid***	2020
	2021		New Minister appointed						2021
	2022 ….						Denmark joins Arctic council members to suspend Russia	Russian war in Ukraine	2022 ….

Appendix 4: Evolution of priorities in OECD's Flagship publication *STI Outlook*

Table: High level themes in the OECD's Directorate for Science, Technology and Innovation flagship biennial publication: *STI Outlook* (1998-2023)

	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2021	2023
Feature Theme of publication	First instance of the STI Outlook publication available. No feature theme	No feature theme	No feature theme	No feature theme	No feature theme	No feature theme	No feature theme	No feature theme	No feature theme	Relaunch report under new name. The 'i' in STI Outlook changes from Industry to Innovation	"Adapting to Technological and Societal Disruption"	"Times of Crisis and Opportunity"	"Enabling Transition in Times of Disruption"
Selected high level indicative themes (often first mentions by this pub. Series)	Industrial performance, competitiveness	Progress towards a knowledge-based economy	Strengthening the knowledge-based economy	Role of Public Private Partnerships to promote innovation	Globalisation of R&D	Global Dynamics of R&D	R&D for new sources of economic growth, especially Green Growth	Innovation clusters and smart innovation;	Assessing impact of public research (the 'impact agenda')	Public engagement in research and innovation	Shortcomings of current STI policy measures	Urging governments not to find savings from STI budgets when they are needed for Climate Emergency & SDGs	Transformation in Socio-technical systems
	Policy support for productivity and growth	Industry-Science Relations and innovation networks	Industrial globalisation and restructuring	Innovation in the service sector	Collaboration and networking among innovators	Public Sector Financing	Academic entrepreneurship	Comercialisation of public research	Innovation for societal challenges	Public sector innovation	How SDGS are re-shaping STI policy agendas	Innovation systems as part of stimulus packages in post-covid recovery	Urging governments to be "ambitious and act with urgency on socio-technical transitions"
	Revitalising mature industries	The impact of public R&D expenditure on business R&D	competition and cooperation in innovation	supply of human resources for science and innovation	Support to business R&D	R&D in key sectors	Global Financial Crisis R&D investment	Open Science	Mission oriented public research	Strategic public-private partnerships (PPPs)	The 'digital revolution'	Promote system transformations for managed transition to more sustainable, equitable and resilient future	Urging governments to "design policies to enable transitions to new markets to emerge."
	How ICT technologies affect the science system		International mobility of Science and technology personnel	Contribution of multinational enterprises to growth and innovation	Strengthen Public Research Organisations	R&D personnel training and mobility	Competition from emerging economies	Networking and innovation clusters	Societal and environmental challenges: digital; rare diseases; space; oceans; bio-economy	Enhanced access to publicly funded research	Resolving global challenges through international collaboration	Launch of new program: S&T Policies 2025: Enabling Transitions through Science, Technology and
								GFC recovery and key themes: 'Green innovation; Aging society					

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