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Unboxing innovation policy strategies: an empirical exploration on objectives, coordination, and capacity

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"Modernity is complex (Niklas Luhmann), accelerated (Hartmut Rosa), and multiple (Shmuel N. Eisenstadt), it is shaped by capitalism, digitalization, and globalization, and it has vulnerabilities due to climate change, pandemics, global social inequality and threats of war and terrorism." (Busen, Weiß 2023, p. 5)

1 The puzzling observation: the emergence of national innovation policy strategies

In times of multiple crises, "vulnerabilities", and the need for the so-called twin transition – the transformation to a more sustainable and digital economy – science, technology, and innovation (STI) are expected to contribute to solving the grand challenges of humankind. Regarding the related policies, we observably entered an era of strategy that started in the mid-2000s. Nation states started to set up large-scale policy strategies to support innovation-related research and development (R&D) activities, which might generate solutions for existential problems[1]. But how do individual policymakers - from formulators at ministries to implementors at agencies- perceive this development and how does it alter their practical work? This contribution will focus on the perception and practice of individual policymakers working within or close to state authorities in Germany, Sweden, and the UK by an empirical investigation on guiding principles, coordination practises and strategic capacities of the involved actors concerning both: the formulation and enactment of STI policy strategies.

Among others, prominent examples of this policy phenomenon are the Swedish initiative Innovative Sweden – A strategy for growth through renewal from 2004 that was replaced by The Swedish Innovation Strategy in 2012, the British Innovation and Research strategy for growth from 2011 and Germany's four generations of Hightech Strategies (BMBF 2006, 2010b, 2014, 2019) with its successor: the recently introduced Future Strategy: Research and Innovation (BMBF 2023b).

This development is not only restricted to Europe. For instance, the Obama Administration also established a national innovation strategy in 2009, "A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs," updating it in 2011. China also joins in this undertaking by establishing a National Medium- and Long-term Science and Technology Development Plan (2006-2020), considered the Chinese national innovation strategy.

The conceptualization of innovation strategy policies is not limited to nation-states, however. The release of "*The OECD Innovation Strategy*: *Getting a Head Start on Tomorrow*" in 2010 serves as an example of the engagement of an international organisation in that respect (OECD 2010). Furthermore, the executive organs of the European Union, with their supranational institutional structures, have been involved in formulating an innovation strategy for quite some time. One milestone of this process was the Communication from the Commission *EUROPE 2020 – A strategy for smart, sustainable, and inclusive growth (European Commission 2010)* that led, among other building blocks, to the formation of the *Horizon 2020 – Framework Program for Research and Innovation (European Commission 2011)* just a year later. The aim of the latter was bringing "together all existing Union research and innovation funding, including the Framework Program for Research, the innovation-related activities of the Competitiveness and Innovation Framework Program and the European Institute of Innovation and Technology (EIT)" (2011, p. 2) in a combined strategy.

[1] Furthermore, these strategies often put the focus (of the wording) on innovation, integrating the policy domains of science and technology as well, at times blurring the boundaries of the different areas from the observer's perspective.

Although all these policy strategies stem from different responsible authorities in different countries with diverse governance settings, they have multiple aspects in common.

The first apparent feature is the commitment to support STI, which should help solve the "Grand Challenges of our time" formulated in the Lund Declaration 2009. Accordingly, these "challenges must turn into sustainable solutions in areas such as global warming, tightening supplies of energy, water and food, ageing societies, public health, pandemics and security." (Vetenskapsrådet 2009, p. 1) This objective can also be found in the US Strategy, which ought to "harness science and technology to address the "grand challenges" of the 21st century" (Exe.Off. of the President 2009, iif). Compared to the Lund declaration, the US challenges are vividly described as "developing solar cells as cheap as paint, building anticancer drugs that spare healthy cells, and fitting the contents of the Library of Congress on a device the size of a sugar cube." (2009, p. 5) This main feature of shifting the focus of STI policies towards an aspired more significant societal impact, however, is a complex undertaking: "While this re-orientation towards addressing challenges, which can be empirically observed, might be welcomed from a normative point of view, it poses significant challenges for the substance, procedural design and coordination of STI" (Lindner et al. 2016, p. 1).

Secondly, following the narrative on tackling those challenges, the innovation strategies all mention long-term goals, spanning over legislative periods or even generations, as the titles, for instance, Horizon 2020 and Hightech Strategy 2025, already indicate. However, adding time horizons to the strategies' headline does not necessarily result in formulating concrete milestones, specific timelines, and indicators to assess progress towards tackling these challenges in the corresponding strategy policies.

The third apparent standard narrative of the strategies is the cross-ministerial constitution of those goals, which implicitly and often also explicitly suggests that several ministries need to be involved in designing, formulating, and implementing the related policy instruments. Furthermore, they draw on existing measures and simultaneously add new policy instruments. Those inter-departmental efforts pay tribute to the cross-cutting character of innovation itself. According to Kaiser, commenting on innovation policy and its strategies of the mid-2000s, these "do not display a novel field of political actions altogether: It is rather the extension of a more traditional understanding of innovation policy as an "interchapter between industry policy as well as science and technology policy" (Meyer-Krahmer 1989, p. 1), to a much more comprehensive policy approach (Borras 2003)" (Kaiser 2008, p. 8). This aspired inclusiveness of programmatic strategies is also proposed by a former OECD expert: "An innovation strategy […], has to take account of [cultural, geographical, legislative and regulatory] conditions to ensure that any interventions combine to contribute to the policy goals and do not weaken one another […] with emphasis on whole-of-government policies" (Gault 2010, 92ff). More than a decade after Gault's observation was published, the "European Commission, in close collaboration with the European Research Area Committee delegates, launched a Mutual Learning Exercise on the application of a whole of government approach (WGA) to the design and implementation of national research and innovation policies."[2] In practical terms this means that the above mentioned observation has turned into a policy exercise and monitoring practise within the EU (European Commission. DG Research 2023a) to support the policy design of emerging innovation countries such as Bulgaria (European Commission. DG Research 2023b).

Fourthly, all strategies went through an editorial process that involved actors of the political and administrative sphere, e.g., different departments, parliament in general, and research and innovation agencies, which had to activate their institutional capacity working towards a joint agreeable document in terms of content (e.g. policy instruments and their direction) and linguistic style (e.g. fitting narratives to instruments). A further observation is thus: through the joint editorial processes,

[2] https://op.europa.eu/en/publication-detail/-/publication/c6f35ad2-be33-11ed-8912-01aa75ed71a1/language-en, online last accessed 26.11.2023

national strategies serve as means to coordinate and navigate towards compromises within the "ingroup of policymakers", as well as an end of communicating action towards the "receiving end" of the associated policies like, e.g., research organisations, companies, and universities. If these activities also involve a concise design, formulation, coordination, and implementation of the associated policy measures, which would also rely on specific strategic capacities of policymakers, is yet an open question.

Although the "humble observation" of Borras and Edler can still be shared today, that „ how the change in socio-technical systems and innovation systems (ST&I systems) is actually governed remains understudied in the social sciences" (Borrás et al. 2014, p. 2), this contribution falls short of comprehensively analysing the actual content and execution of the national strategies. It will instead explore the perceptions and understandings of the "ingroup of policymakers" – representatives and officers at the ministries and agencies – concerning the complexity of shaping and the ability to (possibly) orchestrate policy communities towards change. Furthermore, the observation that "scholars in STS (science and technology studies), economics and political science disciplines have been concerned with the complex micro- and macro-level dimensions of the relation between science/technology and society/economics/politics and their mutually shaping interactions" (ibid.) is shared by the author. Hence, this contribution will focus on the perception and practice of individual policymakers (from formulators at ministries to implementors at agencies) working within or close to state authorities, which has mostly not explicitly gained attention by the scholarly community yet. As the term governance has raised the gaze on the meta-level for the past two decades of policy analyses, serving– among other crucial aspects – as a general cypher for the complex interplay of individual and collective actors in socio-technical systems, including the politico-administrative sphere[3], the perspective of policy practitioners has been slightly neglected, which poses the question: is scholarly theory building running ahead of policy practice? Linked to the modest hope to contribute to shortening this assumed distance between action and analyses by focussing on the individuals' perspective, this contribution aims to examine the following questions through an empirical analysis of a solid body of fifty-three qualitative guideline-led interviews with policymakers (ministries, research and innovation agencies, or research councils) involved:

- **Why** did the government decide to launch a national innovation policy strategy?
- What are the **guiding principles and policy objectives** underlying the national strategy as perceived by individuals formulating and implementing the strategy?
- What patterns can be identified regarding the **coordination and cooperation** of the actors implementing the strategy?
- Does the formulation and implementation of the national innovation strategy require **specific "strategic" skills and capacities** from the actors, and what are they?
- Which **obstacles** for (impactful) strategies and **most urgent systemic challenges** do the involved individuals identify?

The remainder of this contribution is organised as follows: a compact discussion on strategy as a research object in policy science (drawing on literature from the period of the first occurrence of national strategies and the current debate on MOIP, as distinct features of some strategies) in chapter 2 will aid to finetune the categories for the empirical work. Chapter 3 will further elaborate on the research design and choice of the three country cases, followed by the central part (Chapter 4), presenting the empirical analysis and interpretation. Chapter 5 concludes the findings and points out further avenues for research.

[3] Another observation supporting this argument is "Innovation policy governance, arguably very important for the design and implementation of effective innovation policies, is an under-researched topic, on which more work, benefitting from an interdisciplinary perspective (including political science/public administration), is needed" (Edler et al. 2017, p. 17).

2 Policy strategies as an object of study

Reflecting on the above-mentioned questions the overall interest of this contribution is: what kind of incidents are national STI strategies? Are they a new approach to systemic policy making, traditional policy instruments with new headlines, simply a public relations coup or something in between?

Drawing on Swedberg (2012) like Borrás et al. (2020), in their recent work on the transformative role of the state, this contribution can be seen as a "pre-study and early discovery phase" (Swedberg 2012, p. 10) of the phenomena of national STI policy strategy: "that is, an analysis based on consistent insights from empirical observations that serve to conceptualise (and eventually theorise) about a phenomenon that remains understudied (…) [like national STI strategies]." (Borrás et al. 2020, p. 2)

This pre-study is such an "attempt to understand and explain something that happens in society" (Swedberg 2012, p. 14) guided by the first two rules formulated by Swedberg (p.17, original in bold and italics)

„Rule # 1 Observe – and Choose Something Interesting:

You can only theorize on the basis of observation. Anything that can stimulate to a full view of the phenomenon should be used, from sturdy scientific facts to art in various forms. "Don't think but look!" (Wittgenstein)

Rule # 2 Name and Formulate the Central Concept:

Give a name to what you observe and try to formulate a central concept based on it."

After parts of the academic literature on "strategy as an object of study" has been taken into account and categories for the analysis are formulated (2.1), these rules will serve as guidance for the empirical investigation that will recapture public policy practices of national STI strategies.

2.1 Strategies in STI studies prior to the New Mission Era

So far, policy scholars have not yet systematically addressed documents of national innovation strategies as an object of study but "strategic policymaking" **as different models for directed actions focusing** on fostering certain technologies in different contexts. One elaborate attempt, for instance, to develop an analytical model to explain (and support) radical innovation is Strategic Niche Management (SNM), which is rooted in evolutionary innovation economics and operationalized by transition literature and works – among other aspects – with societal experiments and Social Network Theory (i.a. Hoogma et al. 2002). The concept of SNM does – under certain circumstances – include recommendations to policymakers about strategically supporting a certain technological niche, although it is not yet profitable. „[Formulating] [...] a quasi-evolutionary perspective on technical change [...] Rip and Schot [argued] [...] that variation is not blind, as is assumed by many evolutionary economists, but directed to some extent. Technology actors not only anticipate future selection but also try to shape the selection process itself by setting up special programs in R&D settings or demonstration projects." (Schot et al. 2008, p. 539)

However, the SNM approach offers helpful hints in terms of policy strategies about directionality. This term intends to describe the circumstance, that "transformative change not only require that innovations be generated as efficiently and effectively as possible, but also that these innovations contribute to a particular direction of transformative change." (Kallerud et al. 2013, p. 2) However, due to its rather narrow perspective on a specific technology or a technical solution (and the corresponding niche or technological regime according to the heuristic), the SNM approach does not necessarily help to explain or conceptualize support for non-technological drivers and the societal embeddedness of national strategies. A more systemic view in connection with clear goals is put

forward by transition management models (Loorbach 2007, 2010) as emphasized by Weber et al. (2012) in their attempt to formulate different framings legitimizing policies for transformative change: "(…) transition management is about innovation and transformation of the systemic context itself and about strategies to direct this system transformation towards particular **goals** (which in many concrete cases is approximated by the notion of sustainability)." (2012, p. 1039)

Furthermore, since "the model of transition management tries to utilize innovative bottom-up developments more strategically by coordinating different levels of governance and fostering self-organisation through new types of interaction and cycles of learning and action for radical innovations offering sustainability benefits" (Kemp et al. 2007, p. 3) it does provide a more pronounced perspective on **actors** with a focus mostly on the self-organizational part by non-government actors. According to another stream of literature focusing on innovation governance, the analytical criteria for strategic innovation policy are the „existence of an explicit **political vision and priority-setting**; Evidence that the vision and priorities are transposed to the choice, design and implementation of innovation policy instruments."(Borrás 2009: 15) Certainly a clearly expressed vision and corresponding priorities is a major aspect of national policy strategies and often stated in the documents. However, expressing visions does not necessarily mean policymakers always design and implement new policies to address these "corresponding priorities"; they often stick to the already existing measures: "[…]public policies, just like innovations, display irreversibility and path-dependency: they are adopted not on a tabula rasa but in a context of pre-existing policy mixes and institutional frameworks which have been shaped through successive policy changes." (Flanagan et al. 2011:708). Accordingly, the question arises if national innovation strategies are **integration constructs**? And are they "intended to „rationalise" multiple goals and then combine policy instruments in new ways […]" like Rayner et al. 2009, suggested when introducing the concept of *Integrated Strategies* after working on large scale policies for (mainly) environmental protection such as National Forest Policies or Integrated Coastal Zone Management. These programs "attempt to *integrate* existing, and sometimes competing, policy initiatives into a cohesive strategy; to *coordinate* the activities of multiple agencies and actors; and, generally, to substitute a *holistic approach* to a problem for one that has decomposed policy into a set of multiple and apparently unrelated problems and solutions (Briassoulis 2004; 2005; Stead et al. 2004)." (Rayner et al. 2009, p. 101). Furthermore, policy integration was identified as a phenomenon or, better – necessity – marking the development from environmental policy plans to the very first Sustainable Development Strategies (Meadowcroft, 2007; Steurer, 2007), which also feature "addressing cross-sectoral challenges" just like innovation strategies. Steurer also highlights the importance of administration in that respect:

> *"Both scholars and practitioners address the issue of policy integration often by discussing particular policy instruments (such as Environmental Fiscal Reforms) or mechanisms (such as inter-ministerial coordination structures) rather than by exploring new, more appropriate patterns of governance or administrative narratives in general. However, since policy integration strongly depends on better coordination on the administrative level of government, I advocate that the challenge cannot be met without an adequate administrative pattern in place." (Steurer 2004, p. 2).*

Since most STI policy strategies also rely on "**inter-ministerial coordination structures**", according to the document analysis (see 3.1 for an overview on the strategy cases) this impetus for sound and effective coordination routines is worth investigating when looking at the core aspects of national strategies. Furthermore, the holistic claim of a national strategy might benefit from the individual yet systemic perspective Raschke and Tils put forward with their groundwork publications on the matter (Raschke et al. 2007, 2010, 2011). They describe "Political Strategy"[4] of individual and

[4] Even though the focus of Raschke & Tils lies on „political strategy" not „policy strategy", which in German words can be more distinctly described as „politische Strategie" not „Politikstrategie", their conceptualisation is still useful in this context.

collective actors as "success-oriented constructs, which rely on cross-situational calculations that consider the goal, the means and the environment." (Raschke et al. 2007, p. 127) These calculations constitute furthermore "directed, systemised and *calculated considerations* (calculations) that aim at *desired conditions* (goals) for targeted *options for action* (means) by taking into account the cross-situational, *relevant context* (environment)." (2007, p. 129, original in italics, own translation) Keeping this definition in mind, it is also proposed that policymakers cling to a certain "orientation-scheme [...], that guides their actions throughout the entire process of the strategy-making, therefore when developing strategic capability[5], designing strategies and in strategic steering processes." (ibid., p. 80) The latter might even be the very crucial core of an innovation policy strategy since its overall impact relies on the answer to whether or not steering processes towards solving the grand challenges by STI activities can a) even be enacted by a single or collective core actor such as a ministry or government cabinet and b) are carried out successfully aiming at a certain target and direction. Supplementary, Raschke & Tils connect to the aspect of belief systems, in their words "orientation-scheme", which according to Sabatier & Jenkins (2010) relates to sets of priorities, values and causal assumptions, which would need to approve and incorporate the overall strategic demands.

Another crucial aspect is the dynamic process dimension: to set up a meta-scheme for policy measures that foster environmental innovation, Quitzow distinguishes similar elements of policy strategies and points to the recursive process dimension and the importance of strategic capacity: "The process of strategy development and implementation is an ongoing and iterative process, which requires continuous and systematic review and adaptation of policy measures (**Process dimension of strategy**)" (Quitzow 2012, p. 9)

2.2 National STI Strategies and mission-oriented innovation policies: two sides of one coin?

A key motivation for the investigation of national innovation strategies is the observation that this policy phenomenon, first occurring around the mid-2000s appears to be the comprehensive commitment to achieve both meta-targets of contemporary societies by STI policies: solving grand challenges associated with fundamental and systemic threats like climate and demographic change while simultaneously enabling economic growth and prosperity. Around the early 2010s, however, the notion of new mission-oriented innovation policies (MOIP) – sometimes just referred to as missions – respectively, entered the political arena and seems to have taken over the vivid debate on strategic policy making and policy strategies that had just gained momentum (Gault 2010). Since MOIP and innovation policy strategies share the same motive – (a) grand societal challenge(s) – and ambition in terms of "addressing" (ideally solving) it/them by STI to facilitate real transformative change, it is plausible to argue that each mission is a policy strategy in its own right. MOIP – be it *fighting cancer*, an example from Germany's Hightech-Strategy 2025, or the *Industrial Clusters Mission*, an example from the UK strategy of 2019[6] claiming to "establish the world's first net-zero carbon industrial cluster by 2040 and at least one low-carbon cluster by 2030" – obviously have to establish, train and pull together their own set of policy capacity, instruments, budgets, target groups, and evaluation practices.

The point is: MOIP and national innovation policy strategies stem from the same core understanding, that STI are mostly publicly financed to provide solutions for the most pressing challenges if

[5] Strategic capability in this context is defined as the „distinct ability for target tracking [...] which is not only the cognitive capacity, but also the strategic capacity for action of an (organized) collective actor [like a party or ministry]". (Raschke et al. 2007, p. 274).

[6] https://assets.publishing.service.gov.uk/media/5ce3c654ed915d247e03364c/industrial-clusters-mission-infographic-2019.pdf , last accessed online: 29.11.2023

drafted accordingly (Foray et al. 2012; Kattel et al. 2018; Mazzucato 2017; Robinson et al. 2019). And both types of initiatives do – more often than not – follow similar policy principles and practices pursuing a specific direction. Nevertheless, national strategies in addition encompass more general targets like increasing skilled labour or strengthening knowledge transfer between heterogeneous actors to secure economic growth and prosperity. MOIPs are ideally more focused on constructively contributing to the solution of an explicit societal challenge and are embedded in specific socio-technological systems that they seek to change or adapt to new circumstances or conditions (Wittmann et al. 2021b; Wittmann et al. 2021a). MOIPs – as critical elements of most national innovation strategies today – can therefore be interpreted as carriers of attempted directionality[7].

But as Wanzenböck et al. (2020, p. 484) have recently argued, "the policy discourse about directionality and mission-orientation insufficiently considered the contextuality of societal challenges related to different views on both the problem and the solution." Following this argument it might be the case that there is still a missing embeddedness – or better resonance – of STI policies within the group of addressees of the associated funding programmes as well as society due to the fact that the complexity of steering towards change via STI measures has been underestimated right from the very beginning in the mid-2000s (see 4.2. for an empirical perspective on this statement). Furthermore, Janssen et al. offer another impulse to the MOIP debate by describing them as boundary objects:

"This entails bridging understandings of missions as a guiding principle in strategic policy debates—where stakeholders engage with the MIP [Mission Innovation Policy] concept but adapt it to their particular challenges—and the actual implementation of the mission they formulate. We argue that to facilitate the so far troublesome operationalisation of MIPs, what is necessary is not a very prescriptive set of design principles, but instead understand missions as 'boundary objects' (BOs) around which heterogeneous communities—comprising but not limited to policymakers—gather and craft together shared understandings of what is at stake, what means are necessary, and what processes should ensue." (Janssen et al. 2023, p. 399).

This concept states a workable, flexible concept but does allow for the interpretation: missions have simply not yet lived up to their expectations. One can think of many reasons in addition to Wanzenböck et al. why this promising concept does – so far – not unfold its full potential, but the expectation and excessive demand for real transformative change by the STI activities fostered by MOIP have been enormous right from the beginning and "their effectiveness [...] is still be proven" (Larrue 2021, p. 12). Therefore, the empirical material and analysis of this contribution will return to the initial phase of national innovation strategies and their missions (the period from 2006 – 2014) to investigate where this overload, or missing expectation management towards the transformative power of this policy field might be rooted.

[7] Discussing the concept formation and current use of the term *directionality* would exceed the scope of this contribution. But just like Andy Stirling in his presentation at the Eu-SPRI general conference in 2023 vividly de-mystified the term "political roadmap process" for prioritising support for technological infrastructure ("They are always linear, what does that have to do with a real roadmap?"), one might question the meaning and potency of the popular term directionality as a catch-all phrase for (ideally) steering towards a holistic direction of change, somehow calling into question that policies before the era of MOIP had a direction at all.

3 Choice of cases & qualitative analyses

To try to recapture public policy practices around national innovation strategies, guideline-based interviews and their qualitative analysis was chosen to gain two main insights. Firstly, the focus on the perception of the practitioners in charge will serve to identify the spirit and goals of the strategy and its underlying processes from an empirical perspective reaching beyond a document-based analysis and the headlines of communication material. Secondly, discussing the past views and future opportunities for strategies and their elements by interpretative reasoning and theorizing of the learnings will help to identify recommendations not only for future policy strategies but also for further research on the matter. Or in the words of Lowi from the early days of policy analysis: "[...] if we can discover empirically the policy conditions underlying our political patterns, we have a basis for better public policies as well as better political science" (Lowi 1972, p. 309).

3.1 Choice of cases

To find tentative answers, three countries have been chosen for further investigation, namely the UK, Sweden, and Germany. The selection is based on two reasons, first the pragmatic aspect of timing, as these countries established strategies roughly around the same time and have been renewing them with every change of government[8] while being members of the European Union at the time when the interviews were conducted. The second reason is related to the strategies meta-targets of enabling economic growth and prosperity while possibly following (slightly) different normative assumptions considering regulatory policies and the role of the state as such. On that account it is useful to also select the cases along the Varieties of Capitalism heuristic (Hall et al. 2001; Hall 2001; Hall et al. 2009). While acknowledging the original focus on firms and its general contestations (Hancké 2013), according to Streeck it still enables "considering capitalism as an institutionalized social order. Conceiving of capitalism as a social order draws attention to the micro-dynamics of its enactment and re-enactment within a specific context of instituted constraints and opportunities." (Streeck 2013, p. 3). Therefore, the UK is chosen as an example for a (sort of) Liberal Market Economy which, in the aftermath of the financial crisis in 2008, is trying to recalibrate and improve its knowledge and technology transfer from science to businesses. Sweden serves as a small state example representing a (sort of Scandinavian social democratic) hybrid economic system (Crouch 2013), with a prominent division of labour between the ministerial authority and appointed policy implementors in agencies. Whereas Germany is considered a (sort of) coordinated market economy (CME). Even though STI policy strategies are not (solely) focussed on firms and market creation, this heuristic is still helpful in choosing the cases, since the "institutional complementarities" (Hall et al. 2009) within national economies and the support and commercialization of "the new" is crucial. Summarizing his empirical investigations, Wood, outlines why this might be instructive for public policy: „In an LME [Liberal Market Economy], where relations between firms are mediated by markets, the state will be more effective if it restores and 'sharpens' market mechanisms. In a CME [Coordinated Market Economy] effective policy consists in supporting the institutions and networks of coordination that connect companies." (Wood 2001, p. 274).

3.2 Sample of interview partners and method

All interviews were conducted via online calls (via Skype) and all interview partners agreed, that the exchange was recorded and transcribed. The shortest conversation took 27, the longest 118 minutes, and all interviews took place between March 2013 and April 2014. All respondents were

[8] The political systems however, UK Westminster Democracy with monarchy, Sweden parliamentary monarchy and Germany a parliamentary democracy with a strong federal system, will not play a role in the investigation.

contacted by the author by email first. German representatives were identified via the organizational charts of the ministries, e.g., the Forschungsbeauftragte (representatives for STI) of each ministry, or by personal recommendations of colleagues. Swedish and British interview partners were identified by direct inquiry via the ministries or agencies' contact offices or by personal recommendation. As for the selection of the interview partners regarding Sweden and the UK, the sample contains both representatives of the ministries in charge of the strategy documents and employees of the agencies, responsible for formulating and implementing the corresponding policy instruments, mostly Vinnova for Sweden and the Technology Strategy Board (now Innovate UK) for the UK. Though Germany also employs agencies to implement and administer policy instruments, the hierarchical structure of decision-making is very different from the other two cases (see 4.4 for further elaboration) and is mainly limited to the ministries themselves.

Table 1: Sample of interview partners

Germany **17 Interviews:** **3 women, 14 men**	**United Kingdom** **18 Interviews:** **6 women, 12 men**	**Sweden** **18 Interviews:** **7 women, 11 men**
Ministries		
8 x Federal Ministry of Education and Research 3 x Federal Ministry for Economic Affairs and Technology[9] 2 x Federal Minister for the Environment, Nature Conservation, Housing, and Reactor Safety[10] 2 x Federal Ministry of the Interior and Community 1 x Federal Foreign Office 1 x Federal Ministry of Food, Agriculture and Consumer Protection[11]	6 x Department for Business, Innovation and Skills (BIS)[12] 1 x Academic, seconded to BIS (co-author strategy)	4 x Ministry for Enterprise[13] 2 x Ministry of Education and Research
	Agencies, Research Councils & Associations:	
	7 x Technology Strategy Board[14] 2 x NESTA (National Endowment for Science, Technology, and the Arts): Innovation Agency for the Social Good 1 x Research Council 1 x PERA Int. Research Association	8 x Vinnova (Innovation Agency) 2 x Tillväxtanalys (Swedish Agency for Growth Policy Analysis) 2x Vetenskapsrådet (Swedish Research Council)

[9] In 2023: Federal Ministry for Economic Affairs and Climate Action

[10] In 2023 Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

[11] In 2023 Federal Ministry of Food and Agriculture

[12] In 2023 Department for Business, Energy & Industrial Strategy

[13] In 2023 Ministry of Climate and Enterprise

[14] In 2023 Innovate UK

Considering the qualitative analysis, the three focus areas

I. Frameworks for policy making – guiding principles and characteristics of the strategy,
II. Policy practices – coordination and cooperation pattern of the strategy,
III. (Strategic) capacities – skills and capacities of the involved actors,

were set deductively from the scholarly literature (2.1) and the strategy documents (see A.1) and built the first hierarchical code structure. The further sub-categories (30 in total), such as *process*, *benefit*, or *monitoring* as selected examples, were formulated in a second order according to the content of interview passages marking observable recurring incidents (inductive categorization). Furthermore, a third order of categories (around 110) was established along the material that explicitly further conceptualized the codes or quotes. One example from the segment of monitoring is the "need for new indicators". To ensure a focussed and systematic analysis of the qualitative interviews, the established methods and routines were followed (Kuckartz 2014; Mayring 2014; Rädiker et al. 2020), with a particular focus on the coding techniques advocated by Corbin et al. (2015). The software MAXQDA 2022 was used for the analysis. As the potential for conceptual and practical reflections on the gathered empirical material is vast (1512 individual quotes)[15] the paper focuses on the five core questions listed in Chapter 1 (the interview guideline can be found in the Annex).

[15] Further topics for possible future investigations include the interviewees perspectives on different policy instruments and mixes applied, on monitoring and impact assessment, the role of advisory committees and division of labour between research councils, agencies etc., agenda setting between the EU and the nation states, project and program planning, time horizons and strengthening the role of companies in innovation policies.

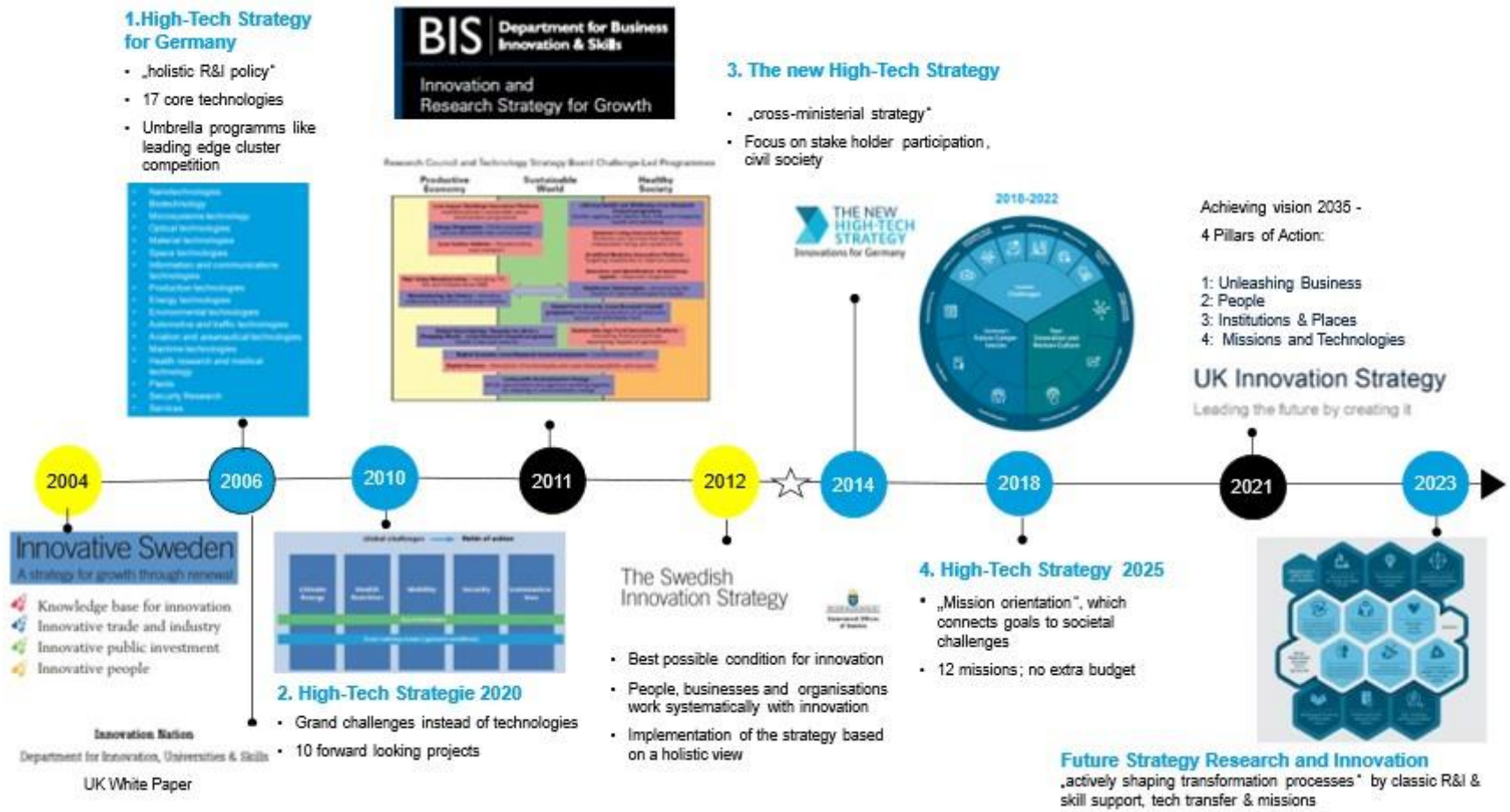
4 National innovation strategies: productive features and excessive demand

The practise of national innovation policy strategies dates to the mid-2000s when Sweden (in 2004: *Innovative Sweden*) and Germany (in 2006: *Hightech Strategy*) introduced their first policy documents; while the British White Paper "Innovation Nation" (also published in 2006) was the first conceptual attempt towards a policy strategy which was ultimately introduced in 2011 (*Innovation and Research Strategy for Growth*). Figure 1 depicts the evolution of the strategies since 2004 and displays two observations on frequencies: firstly, German subsequent national governments introduce a new strategy after each election with a distinct corporate design and elaborate communication campaign; secondly, both British and Swedish governments have so far published a new strategy every ten years (and leave the implementation and further elaboration of workable concepts and policy instruments to agencies, notably the British Technology Strategy Board[16] and the Swedish Innovation Agency Vinnova[17], both non-departmental public bodies, and research councils).

[16] The British Technology Strategy Board (TSB) was established as a separate organisation in 2007 and is a non-departmental public body sponsored by the Department for Business, Innovation and Skills. In 2014 the TSB changed its name for communication purposes into Innovate UK which is part of UKRI, but the legal name TSB still exists.

[17] The Swedish agency Vinnova was established in 2001 and is a government agency under the Ministry of Climate and Enterprise, and the national contact authority for the EU framework programme for research and innovation.

Figure 1: Timeline of national innovation policy strategies in Germany (blue), Sweden (yellow) and UK (black)[18]



[18] The star indicates the interview period between March 2013- April 2014.

Since the analytical focus of this contribution lies on the qualitative analyses on the perception and practise of public servants in ministries and agencies, a detailed document analysis was omitted but a comprehensive presentation of main strategy categories can be found in A.1.. Because the empirical material was gathered between March 2013 and April 2014, the interview partners refer to the policy practises and documents from this period (as indicated by a star on the timeline in Figure 1), notably: The *German Hightech Strategy 2020* (BMBF 2010a), the British *Innovation and Research Strategy for Growth* (BIS 2011) and *The Swedish Innovation Strategy* (Swedish Ministry of Enterprise, Energy and Communications 2012). As a starting point for the analysis, the vision statements have been selected to showcase the policy ambitions and foci (Table 2). All of them attribute an influential and forward-looking role of the state with the idea of market creation and growth, with the German example advocating to "find solutions to global and national challenges" by joining scientific and economic forces, the British clearly stating intervention actions by its agency "when the market is unable to foster innovation alone in critical technologies or sectors" and finally the Swedish pointing out the creative economic potential of all regions by stating that "People in all parts of Sweden can and want to contribute to creating value".

Table 2: Vision Statements of National Innovation Strategies

Vision Statement	we want to stimulate **Germany**'s enormous scientific and economic potential in a targeted way and find solutions to global and national challenges. Germany must continue its efforts to open up promising lead markets through innovation, develop these markets through social changes, and thus secure material, cultural and social wellbeing. (BMBF 2010a, p.3)
	UK: This strategy is based upon an understanding that Government can be an important driver of innovation. We will support independent bodies, like the Technology Strategy Board, to intervene when the market is unable to foster innovation alone in critical technologies or sectors. More commonly, we will work with the grain of the market by getting rid of unnecessary red tape, making public sector data more accessible and establishing a fund to run inducement prizes in areas where innovation is needed. (BIS 2011, p. V)
	Sweden is a creative country characterised by pioneering ideas and new ways of thinking and doing in order to shape our future in a global community. People in all parts of Sweden can and want to contribute to creating value for people, the economy and the environment through new or improved solutions. (Swe. Min. EEC 2012, p. 13)

(BIS 2011; BMBF 2010a; Swedish Ministry of Enterprise, Energy and Communications 2012)

4.1 Contextualisation and motivation

Considering the historical process and motivation to formulate and implement a national innovation policy strategy most interview partners argued that there was a general supranational European consensus and expectation that STI should aid solving the "grand societal challenges" of our time. To ultimately tie in with this grand narrative – particularly in the wake of the Lund Declaration in 2009 and the Europe 2020 strategy introduced in 2010 – a new, committed and encompassing policy statement was needed. An interviewee from Germany shares the belief that expanding the expectation on STI contributions towards solving global challenges in (Western) European industrialized countries is an effect of the past 30 years prior to the turn of the century that the narrowed

view on regional environment problems was complemented by the perception of global threats and solutions that cannot be solved by single states:

> "*In the 1970s we had regional environmental challenges and followed slogans like: the sky above the Ruhr must turn blue again. […] [Nowadays], we have nearby national environmental problems like air pollution, water pollution, waste disposal reasonably well under control. […] But the global environmental problems that violate the sustainability goals are still a long way off and we can only solve them as a world community. The discussion about global climate change, global environmental changes have become more important, in recent years*." (GER_5, Pos. 23).

Furthermore, the understanding of innovation as – exceptions prove the rule – a result of cross-cutting (or even systemic) activities and decades of interplay between policy and academia in connection with the associated scholarly analysis and debate about heuristics of *national, regional, sector and technological systems of innovation* (e.g. Braczyk et al. 1998; Carlsson 1995; Edquist 2005; Lundvall 1992; Malerba 2002; Nelson 1993) had led to a political recognition and willingness to address the involved actors from science , society and industry in a more holistic manner (Warnke et al. 2016). As the following selected statements illustrate, the believe in the combined forces of the "overall system" is shared among the three cases, with the British ministerial servant pointing out the need to better align their excellent research base at universities with the overall system and the lack of support for development and commercialisation aspects so far:

> "*And the other motivation for the strategy is, we want to improve the national engagement of the overall system: UK universities are very good in engaging with founding programs, they are very international within the academic system. But that's academic research, UK has not been very productive in innovation. It is not supporting RnD and business, the commercialisation, technology. And yet we also have huge geographical disparity in the UK.*" (UK_1, Pos. 26).

A similar, yet reverse, take is expressed by a Swedish ministerial representative, thus taking the business focus of innovation policy as the perspective that needs to be broadened:

> "*So, we decided: let`s do a comprehensive innovation strategy and take the global challenges as a point of departure. We cannot look at innovation only from the business sector. We must put another focus, […] as a tool, as a perspective and as a venue where different organizations, different perspectives, different resources, and competences can meet and combine to develop these new solutions that the society needs and that will also lay the foundations for the future competitiveness. […] We received quite some heavy criticism for not being focused enough […]. Then again, my response to that was, that we have made a very well underpinned strategic choice for an all-inclusive innovation strategy.*" (SWE_15, Pos. 41-43).

Furthermore, a kind of spill-over effect of the academic debate on the systemic nature of innovation, coupled with the perception of positive experiences in other nation states was notably one of the driving forces of the holistic narrative behind the German strategy, according to a ministerial representative who was involved in the formulation, design and implementation of the first strategy:

> "*I would attribute the [aspired] systemic approach of the Hightech-Strategy to two motivations: On the one hand, there was a lot of advice from the scientific community, […], that innovation was increasingly understood as a holistic activity, and it became acceptable to ask for a policy strategy in one casting ["aus einem Guss"]. All the buzzwords of systemic policy, which had already been circulating since the nineties, were increasingly negotiated in Germany and in some cases already played a role in other European countries. I do not remember exactly when – among others – the Finns started, around 2002, 2003…insofar, and this is the second reason: there were already successful examples in the OECD." (GER_11, Pos.10-11).*

In addition to observing motivational similarities, a look at the **specific national circumstances** at the time, when the first strategies were introduced, will provide insights that mirror the expectations on the effects and long-term impacts of the strategies right from the start. Staying with the German example, the public servant provides more anecdotal insights about consensus in cabinet and personal engagement by the chancellor at the time, that research should be given higher priority and

> "[…] *the policy field should receive more attention and political ambition. This upgrade was pursued by both, Ms. Merkel and Ms. Schavan [NB: Research Minister at the time], as a tandem. To achieve this, it had to become a policy field, which was expanded from the narrow client base of science towards a broader public including industry." (GER_11, Pos.14).*

An additional perspective refers to the political consequences and task readjustment enforced by the Federalism Reforms I and II in 2006 and 2009. These were concerning the legal and budgetary responsibility for research and education between the German Länder and the Federal Government. The loss of most of the already limited shared responsibility for education on Federal level is identified as another driving force for the establishment of the Hightech-Strategy by the BMBF, since "*This research ministry [BMBF] looked like a plucked chicken. Plucked most recently by the federalism reform, among other things. Because the education sector was finally torn out of its plumage, for good. Such a ministry – for its raison d'être alone – must reposition itself." (GER_8, Pos. 25).*

Taking the lead in a national strategy that sets out to foster technology and innovation meant repositioning the Ministry for Research and Education as a more important actor regarding not only the future economic development but also an elevated role by caring for key services of general national interest in the areas of e.g., health, energy provision and security. As one observer of the negotiations puts it in retrospective, "*they [BMBF] clearly moved from being a discussant at the table of societal demand to a powerful actor. And we all moved from addressing issues no longer from the supply side of new technologies. This [NB: roll out of the strategy] was really a shift towards societal demand pull and no longer the classic technology push situation." (GER_12, Pos. 47).*

With a strong focus on the financial service sector and a relatively low amount of producing trade the British economy, and particularly London as a financial centre, had suffered enormously in the period of the financial crisis 2007-2010. For this reason, the British *Innovation and Research Strategy for Growth* was driven by the hope to finally overcome the negative effects brought by the financial

crisis. Therefore, it put the strongest emphasis on innovation as a source for economic growth and prosperity compared to the other two cases: "*our manufacturing sector had somewhat suffered from the focus on financial services and so in the wake of the financial crisis […] one of the objectives of the government was the so called "re-balancing". To make non-financial sectors grow." (UK_10, Pos. 43)*

After the election in 2010 the government embarked on a radical program on a) reducing the *public* sector and red tape in order to tackle the high deficit, b) introducing new instruments to bridge the gap between science and industry to speed up commercialization with e.g. founding the Catapult Centres and granting a bigger budget and power to the innovation agency Technology Strategy Board (TSB; today Innovate UK) and c) centralizing the RnD and innovation support. According to a quarter of the British interview partners concerning the latter, the most significant changes to the support landscape in UK was the abolishment of the Regional Development Agencies (RDA), as these representative statements emphasise:

> "*Before the BIS strategy innovation was more of a place-based policy. And the RDA were set up to reduce the differences between the regions of England, (…) and so they were responsible for promoting innovation in a particular area. They knew what was happening in the area and they could choose what to prioritize and where to focus their investment. […] Now their function in relation to the European fund and the framework programs moved to the national level and were transferred to the TSB" (UK_2, Pos. 8.)*
>
> *"[…] the enthusiasm for cutting in the first years led the government to abolish the RDA. There has been a major gap for the support of local innovation in England ever since […] to my taste they destroyed the strategic capability in the areas to identify the successful projects" (UK_6, Pos. 59; 66).*
>
> *"The conservative government when it came in didn`t like the concept of regions and the RDAs because they thought it was a European opposition to Britain." (UK_13, Pos. 57).*

The introduction of the Catapult Centres, however, was fuelled by the hope that these intermediary structures – like the Fraunhofer Society in Germany – might quickly find co-financing by industrial partners and help to reduce time to market of new products and process innovations. To spark the entrepreneurial spirit of the academics and business partners alike, the

> *"Catapults are funded only by one third by government (the TSB) […]and they have to find another third of that budget from contractors through business, and one third through collaborative research projects […]. We [TSB] have a lot of interest in accessing other government department funding, e.g., the Dep. for Transport or the Dept. for Energy and Climate Change." (UK_17, Pos. 188).*

For Sweden, according to the European Innovation Scoreboard one of the most innovative EU states of the past decades[19], the motivation for a national innovation strategy in addition to the grand challenge or mission orientation seemed to be rooted in two different perceived needs for action: first, to align and consolidate the regional with national levels of policy making and second, the chance to take on a new and improved approach to innovative public procurement. According to interview partners there had been a tradition of formulating strong region-specific strategies

[19] See https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en#european-innovation-scoreboard-2023 and current Scoreboards online; last access 15.09.2023

whereas a national strategy taking on a systemic perspective was a new phenomenon. Consequently, efforts had to be made to foster togetherness and spark a joint policy spirit and common understanding of innovation (beyond the well know hubs in the south like Stockholm, Goteborg or Lund/Malmö), as two representatives of the Ministry for Enterprise reported:

> *"We have been travelling around the country to visit different regions. We have had like 12 different council meetings in different parts of Sweden. […] And we talked about what issues are related to the regions. We were inviting people from the universities, the local administrations, local businesses, and a very broad spectrum of participants. […] we have this very broad approach for innovation [and] then it`s necessary to engage people around Sweden to work with it." (SWE_13, Pos. 60).*

> *"When we started the work after the prime minister's announcements, governmental encouragement, and the order from the minister of enterprise we decided the process should include and should be open for all partners of societies that had not been part of the established innovation policy discussions and networks before. So, we had to find a way of engaging broadly with people in the regions within different industries and in different parts, in different systems of society." (SWE_15, Pos. 39).*

In addition to these perceptions an interview partner, representing the Ministry for Education and Research, concluded that, since the regional actors felt that also their local initiatives should be slightly reorganised to better align with the national strategy, proactive regional debates about the strategy were essential, "*because the different regions in Sweden find that changing collaboration should be based on a document that will lead the way. And I think for them [regions] it`s been very important to have this document because it`s been a long tradition of regional innovation strategy and now they face a national innovation strategy […] you`ve got to see different points of view." (SWE_1, Pos. 28).*

Vinnova, the agency in charge of translating the strategy document into funding programmes and further initiatives, embarked on regional policy discussions (as indicated in Figure 2) together with the responsible Ministry and took care of the administrative roll out of the associated projects in regards with the second and third driving forces specific for Sweden: coupling the support for innovative public procurement with the improvement of public services.

Figure 2: Regional discussion fora and pilot projects of innovative public procurement[20]

A representative of the agency elaborates further on the motivation for this action and the associated challenges:

> *"How would you go about to make sure that you enable innovation procurement? How can you give companies the chance to offer new products? Innovative public procurement is important but yet different: You absolutely need something you could always buy, but still sort of open up to the uncertain. […] We spend so much money on new innovation to come forward and when we go into the market mode as a governmental agency, we are very very careful with money. It`s a sort of bizarre balance to spend all that money for people to produce new things and then: who will be buying them? […] Demand in innovation is very important as well, public procurement can be a driver of change." (SWE_12, Pos. 30; 100).*

Notably, no other interview partners put such an emphasis on the topic of public procurement than the Swedish. In addition to the strong statement above, the establishment of the strategic area "Innovation Capacity in the Public Sector" at Vinnova underlined this focus. Communication material of the agency also carries this spirit by acknowledging "Challenges for innovation work in the public sector: Large sums are invested into conceptualisation and pre-studies but too little into development, implementation and use! We define solutions instead of identifying needs! (…) Vinnova contributes to make the public sector a driver for both development and use of innovations!"[21].

[20] Source: Outtake Presentation by the "Public Demand of Innovation" Division, Vinnova, slide 6

[21] Source: Outtake Presentation by the "Public Demand of Innovation" Division, Vinnova, slide 7

4.2 Ideational frameworks for policy making: guiding principles and policy objectives of the strategies

The guiding principles of policy strategies can be identified as a major element of strategy altogether. The willingness to reach a certain goal is a key element and a driving force of strategies in business contexts or concerning military and defence operations as well as policies. Regarding the latter, one must remember that the aim to reach a certain policy goal seems to "tell only parts of the story". The policies are not chosen on a tabula rasa, and instruments always reflect an inherent normativity that replicates the involved polity structure, resonates with the socio-economic context and reveals the current government's value system, the institutional tradition, belief systems and its way of "doing politics".

By asking about the guiding principles, the respondents can reflect upon the underlying values, norms, and thus the contextualization of the goals that they associate with the innovation strategy and its instruments. Furthermore, the perception of the agency representatives should help to learn if meta-goals like *grand challenges* serve as guideposts for actual policymaking (bureaucratic obedience of official guidance) and receive an institutional contextualisation (March et al. 2013; Peters 2006; Schofield 2001). The main questions concerning the investigation on the ideational framework guiding the national policy strategies are:

What do you think are the main characteristics that turn policies into a strategy?

What are the guiding principles and policy objectives of the strategy, in your opinion?

Concerning the first question crucial feedback was given, that around one fifth of respondents even question the possibility of strategic guidance towards (generating) innovation all together when stating *"it`s almost an oxymoron. How can you have an innovation strategy?" (UK_16, Pos. 27)* or stating that there is a disjunct temporal sequence:

> *"A strategy is above all simply designed for long term goals […]. And there is of course a definitional contradiction in what is often called a strategy, when it is clear evidence that these are political-static measures that are simply a reaction to something." (GER_1, Pos. 36).*

The latter of these two representative statements already points towards the single most mentioned characteristic: a national strategy ought to follow and support a **long-term perspective** both, concerning the aspired goals and considering the duration of the support measures:

> *"We need to have consistency: there is no point changing it [the strategy] every 2 to 5 years and expecting you are not to waste a lot of money on the way. You must decide what you are doing, and you must stick with it. […] Every time they [companies] come to us we change the tools, and we change the game. They will be confused. We have to set out a standard set of this is how we operate." (UK_5: 48).*

Even though the time horizon is mentioned as the most crucial aspect, the interviewees raising the issue are at a variance about the realistic time span that fulfils both: tying in with the political dynamics of the legislative periods as well as supporting an "overarching narrative that simply survives elections" (second most mentioned aspect). Most of the policy practitioners are either pessimistic ("*You know, it [government] changes all the time. You cannot go long-term with policies; it would just be a waste of time believing that." (SWE_1: 63); "I do see short term policies only."(UK_17: 63))* or simultaneously realistic and sceptical, considering the effectiveness of promising long-term

missions, as major pillars of strategies, corresponding with short-term policy instruments, timebound budgets and the need to communicate successes *("[…] if we launch an initiative e.g. within a mission it`s so much time two, three, four, even ten years before it shows any kind of effect. And getting the politicians to understand that is quite difficult." (SWE_13, Pos.*101)) A German ministerial representative furthermore reflects:

> *"These missions with their long-time horizons have a characteristic that they must have, but it is difficult for a political actor to deal with them: horizons that extend far beyond the legislative period; political actors can hardly take this into account in their work." (GER_12, Pos. 36).*

Despite the complexity of the time horizon and all associated challenges (e.g. program management and budgetary planning, evaluation and impact assessment practises) most agree that policy strategies first and foremost should set out and communicate "*direction and prioritization of government*", "*display a guiding document, which is agreeable to most – no rule book*", "*create good conditions for processes, both within the politico-administrative as well as STI communities*" and "*encourage people to want to achieve something together"* by providing a certain "flexibility on how to achieve it".

In addition to the frequency of the mentioned characteristics, a contingency analysis revealed that those interview partners (eight people) that mentioned more than five different characteristic elements to define strategies, also admitted being very challenged by formulating and/or implementing the strategies content, while sharing vivid examples of these struggles during the interview[22].

Enabling scientific freedom as a core claim

All three cases refer to scientific freedom as an important foundation of STI policy in general and this aspect has been mentioned by around one third of the interviewees as an important framework condition. The British Haldane principle ("is popularly used to describe the notion that "decisions about what to spend research funds on should be made by researchers rather than politicians"[23]) or Article 5[24] of the German constitution (Freedom of expression, arts and sciences) are legal manifestations of this freedom and need consideration against the background of more "directionality" or challenge-led or mission-orientation in STI funding, respectively. Concrete aspects to consider revolve around the allocation and decision on budgets, as these two quotes exemplify:

> *"The point is, unlike many other countries including some in Europe, a [British] ministry is not really directing science and research money. Because of this [Haldane principle] you cannot have a strategy involving research expenses which comes from the minister or the agency to decide what`s going to be happening with the money. Because you cannot have this directionality within the science and research budget. So, you have to be outside this budget to be guiding certain fields." (UK_15, Pos.22).*

[22] Nota bene to advance more qualitative insights: This contingency might have identified a group of individuals that could be particularly suitable for a cross-national focus group on detecting general voids of demand and reality (Anspruch und Wirklichkeit) in mission-oriented innovation policies, advancing, and possibly overcoming the conceptual and practical shortcomings.

[23] https://publications.parliament.uk/pa/cm200809/cmselect/cmdius/168/16807.htm

[24] Article 5, Absatz 3: Arts and sciences, research and teaching shall be free. The freedom of teaching shall not release any person from allegiance to the constitution.

> *"In the UK there is a very strong version of the Haldane principle. And there is endless debate about what that actually means. But the fact on the ground is, that people accept the research councils and the actual allocation towards certain areas of research and technologies cannot be influenced by politicians." (UK_18, Pos. 34).*

Furthermore, the perspective of technology neutrality (NB: Technologieneutralität) was emphasized by German interview partners (only) and brought forward as one of the unalterable core principles of STI funding per se, as one interviewee states referring to energy research: "[…] *as we, of course, allocate research funds completely neutral; the support from the federal government is completely technology-neutral. […] There will certainly be no single technology that will be focused on individually by the bodies that conduct energy research.*" *(GER_13, Pos. 20)* Another voice raised the issue of neutrality or even non-directionality in more general terms, by mentioning "*this simply contradicts the basic attitude of the current government to single out individual technologies and promote them in this way." (GER_03, Pos. 50-51).*

Grand Challenges and Mission-Orientation as guiding principles

Around two thirds of interview partners (38 or 71,7% of all) mentioned grand challenges (GC) or mission orientation (MO) as a meta guiding principle of the national strategies altogether. Figure 3 presents a hierarchical code-subcode-model with relevant impressions on the matter. When asked to elaborate further on these aspects[25] the responses reflected two intertwined core complexities:

Firstly, a **missing conceptualization and operationalization** that turns overarching (and therefore often overwhelming) headlines in concrete sector specific meaning as a basis for **workable concepts.** These could provide more practical concepts proposing the allocation of political and administrative responsibility and means to formulate, design, implement and evaluate policy instruments and reflect their impact in terms of sustainability and other contribution to solving grand challenges.

Observers concerning the latter – missing workable concepts – mainly mention practical and organizational challenges which point out the necessity to reorganize parts of the politico-administrative work. The yellow chapter in Figure 3 explicates these needs for "deconstructing challenge-led or mission-oriented in project funding" further. Interview partners involved in funding decisions and research project evaluation point out a fundamental adjustment within their domains of decision making, they mention a (necessary) shift towards:

- problem – solution perspective,
- societal instead of institutional compass,
- increased interdisciplinarity and intersectoral work,
- less focus on (countable) results and indicators (e.g. publications), but more on identifying effects (e.g. application of insights),
- heterogenous addressees (of funding), increased complexity,
- beyond domain expertise needed for evaluating proposals.

Furthermore, a group of interviewees already proposed some solutions on how to deal with this "need to break the complexity of grand challenges down in general" (see dark blue chapter for quotes in Figure 3).

[25] "How do you perceive grand challenges as a guiding principle?" and "To what extent can specific objectives, like an orientation towards "solving the grand challenges of our time", provide added value (regarding the strategy)?"

According to those interviewees, the narrative of missions or GC must be very practically coupled with the

- need to create a commercial opportunity,
- focus on competitiveness, growth, job creation: using incentives to twist industry towards GC,
- better resource overview & policy mixes: how much budget in one area and how does that match with another,
- need for an institutional or organizational conduct: the policy landscape should adequately gratify those following the challenge led approach,
- pin-pointing priorities, since there will be interlinkage and systemic effects.

However, the "vague operationalization" is also and foremost a plea for more strategic capacity (see 4.4) and a different dynamic and intellectual (and entrepreneurial) mind-set of the policy practitioners involved, as almost a third of respondents argued (green and partly red chapters), that mentioned GC as a guiding principle. Obviously, these characteristics would also tie in with a different kind of responsibility and decision-making practise (see 4.3)

In addition, the conceptual "paring of societal and technological challenges" is a very demanding and often neglected task, which requires a lot of "scientific, technical and sectoral understanding" by the responsible policy practitioner. Furthermore, the much-acclaimed participatory user involvement needs special attention to grasp the challenge that should be solved in practical terms, here voiced by an agency representative:

> *"[…] to push our researchers and companies to think about needs from different parts of the society not just to focus on selling their products or writing their paper, but really embracing the research and the developing process to actually identifying needs from health care professionals or from teachers or whoever and really working with the user side much more profoundly [is crucial]" (SWE_6, 51).*

Additionally, the obvious challenge on reconciling the paradigm of distributing funding according to "**research excellence** peer review practises" with "**anticipating directionality** and research addressing GC" is a constant "battle". Evidently tough, practical solutions e.g. different calls and funding schemes have been implemented. Thus, just as the traditional controversy about the societal necessity and benefit of basic and applied research has become more differentiated and seems outdated, the debate on allocating funding ("excellent science vs. challenge related projects") and an appropriate policy mix to foster transformative cutting-edge research and driving innovation (in technological processes as well as products and services) is in flux. However, the practical takeaway question from the voices raised here, is the need for new programs and different indicators for choosing projects and evaluating their output and impact.

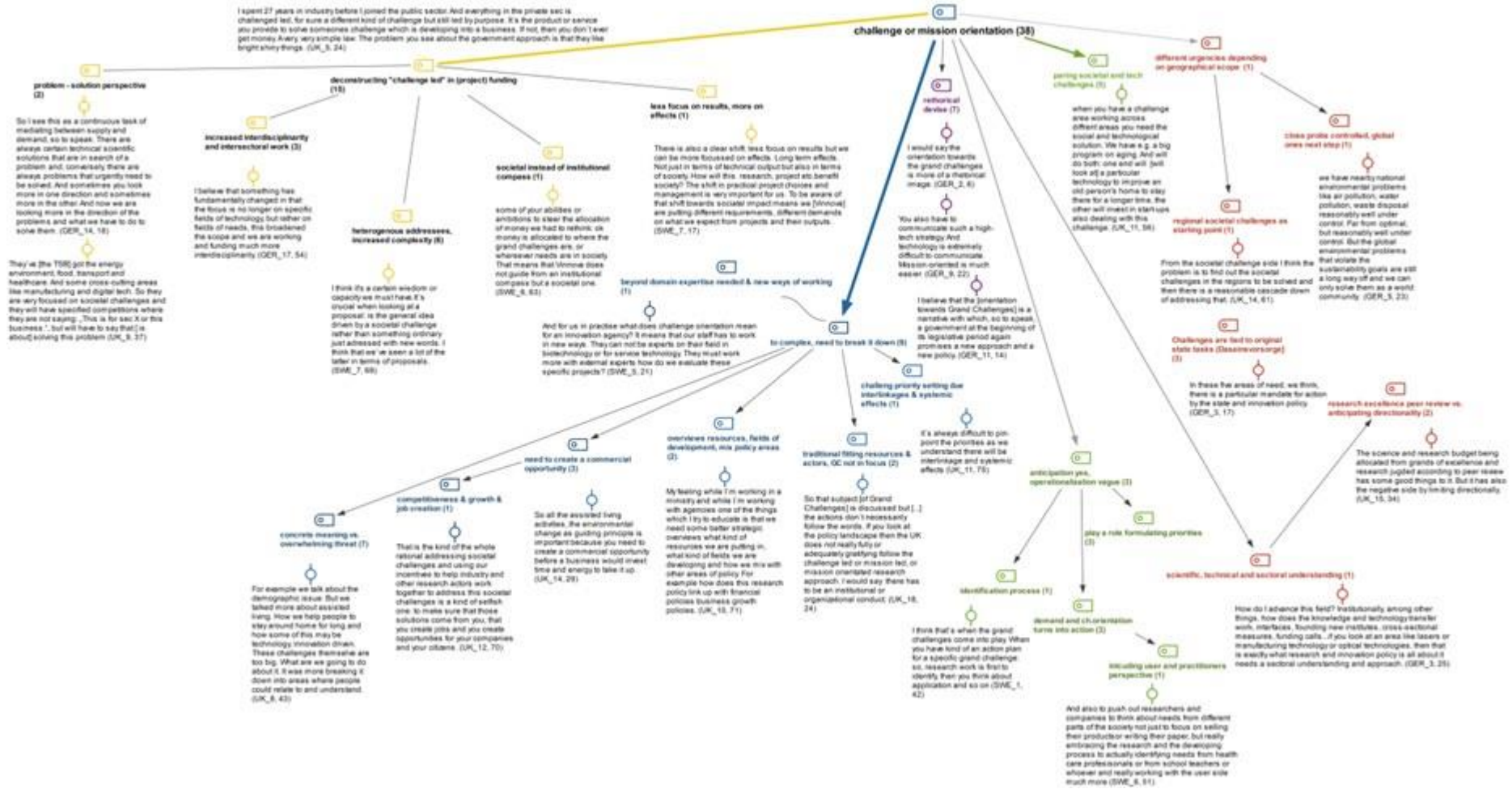
As it has been nearly ten years since the interviews were held, this question has partly been answered by new policies e.g. the Challenge-Led Program by Vinnova, but is often still a challenge to reviewers and evaluators (among other aspects due to interdisciplinary research designs and/or the difficulty to rate and assess the benefit of the outcome and solution contribution towards GC).

Remarkably, only German respondents (7 altogether) indicated that "challenge led" or "mission oriented" for them individually and within their units only serves as a rhetorical cipher and not as a (concrete) guiding principle initiating different policies than before.

Naturally, the **geographical perspective** has also been raised as an important aspect to be acknowledged, on the one hand associated with the practical advice that "*regional societal challenges can serve as starting point*" to draft policies. On the other hand, even though global threats are widely acknowledged as such, the following observation points out that there are of course *differently felt urgencies depending on the geographical location and scope*:

> *"It is certainly the case that not every problem area is of interest to the same group, but that there are countries or groups of countries that are more or less interested in a particular problem area. The USA and Russia are less interested in climate change than other countries. Other areas such as demographics are of course of interest to countries such as Japan, Korea or the like, which are perhaps even more affected than we are." (GER_6, Pos. 12).*

Figure 3: Hierarchical code-subcode-model concerning challenge or mission orientation



4.3 Practises of coordination

Coordination in general encompasses nearly every aspect important for shaping the political agenda, instruments, implementation, outcomes, and impact of policies. Scholars have been working on the subject in enormous detail since decades trying to distinguish patterns of 'good' coordination from empirical cases as well as building theory to contribute to grasp the *coordination puzzle;* this concerns policy studies focusing on e.g. implementation (e.g. Bullock et al. 2021; Sabatier et al. 1979; Schofield 2001), public administration e.g. (new) public management (Hjern et al. 1981; Lynn 2009; Naschold et al. 2000; Peters 2000), aspects concerning the role of (individual and collective) actors e.g. as *street level bureaucrats (Lipsky 1980) or within* advocacy coalition frameworks (Bandelow 2006; Sabatier 2009) and many more issues. Concerning the STI domain, analyses of the coordination in national knowledge and innovation policies settings (Edler et al. 2008; Griessen et al. 2008) and in cross-country comparisons (Edler et al. 2003; Magro et al. 2014) have been made.

But as Braun once asked "What do we mean, exactly, when we speak of the need for coordination with regard to political governance in general and the machinery of government in particular? What kind of coordination do we need to be effective in innovation policy?" (Braun 2008, p. 229)

Well, even against the background of more differentiated "roles of the state in the governance of socio-technical systems" (Borrás et al. 2020) due to more complexity and ambition in policy mixes within mission or GC led programs and the recent appreciation of and appeal for the "entrepreneurial state" (Mazzucato 2013), motivating public organizations and authorities not to restrict themselves to fixing markets but also create them (Mazzucato 2016): when looking at the division of labour within the machinery of government and its departments, policy coordination and the need for it, can still be defined along five objectives, suggested by Painter around 40 years ago in 1981 as quoted by Braun (2008, p. 230):

1. Avoidance, or at least minimization, of duplication and overlap.
2. Avoidance of policy inconsistencies.
3. Minimisation of conflict, both bureaucratic and political.
4. Quest for coherence and cohesion and an agreed ordering of priorities.
5. Promotion of a comprehensive or 'whole government' perspective against the constant advocacy of narrow, particularistic, or sectoral perspectives.

Particularly the latter two aspects, "referring to the coherence of decision making […] [by] drawing separated forces together in order to pursue common priorities and strategies developed on a 'systemic' level (the 'whole government' perspective)," (ibid.) lie at the center of national strategies. As Kattel et al. (2018) observed in addition the "'normative turn' in innovation policy that underlies the search for next generation of innovation policies (Cantner et al. 2018; Daimer et al. 2012; Kuhlmann et al. 2018) is based on much more 'distributed agency'"(p.2), involving more stakeholders from different sectors and strands of society. So, it seems that policy coordination is a fundamental requirement for the challenging and ambitious policy strategies studied here, but is it really sought after by the actors and if so "what kind of patterns can be identified regarding the coordination and cooperation?"

Before turning to the empirical material, one furthermore needs to acknowledge that broadly two segments of coordination have been recognized in the policy debate (Lindner 2012, p. 274 referring to Braun 2008), that are both reflected and referred to in the answers of the respondents:

1. "Policy coordination: Coordination in this area has the objective of developing clear, consistent measures and activities, the agreement on priorities and the formulation of implementation strategies.
2. Administrative coordination: Here, coordination primarily deals with the actual implementation of the goals and strategies that have been agreed upon."

Both descriptions are analytically sound, but this clear distinction is not necessarily applicable or up-to-date with the complex formulation and implementation practices of policy instruments within missions for instance (which is also reflected in some results in chapter 4.4 on capacities). Due to the (formative) nature of STI policies today, there is hardly a clear distinction of policy *time zones* of formulation and implementation possible, still: with a view to national strategies there is surely a distinction between publishing the document (more involvement by the hierarchy in any case) and putting it into action. However, for agency units in UK and Sweden, where the development of consistent policies as well as the administration of these go hand in hand, the cipher "agency with agency" ("Agentur"/Projektträger mit Handlungs- und Gestaltungsmacht) seems appropriate as this quote exemplifies:

> *"We [Vinnova] get a ten-page document from the ministry it really only says you should work with supporting, stimulating, sustainable growth and building effective innovation systems and then we have our annual budget around 200 million €. And that is basically it. These are our guidelines. It is really up to us to develop our own strategy and to really spend the money." (SWE_18: 22).*

Furthermore, in their cross-country analysis for coordination patterns Arnold & Boeckholt (2003, p.27) distinguish not only the segments but also the "levels" of responsibility and actions from a highest Level 1, involving "setting overall directions and priorities across the whole National Innovation System […] through advice to government or […] a cabinet subcommittee. […] Level 2 is co-ordination among ministries, whose sectoral responsibilities otherwise encourage them to pursue independent policies. […] Level 3 is more operational, in an attempt to make the actions of funding agencies into a coherent whole. This level, too, can involve administrative co-ordination […]." (ibid.) Drawing on the document analysis (see A.1) and the interview content (remainder of this chapter) it is recognizable that the cases differ concerning the intensity of involvement of the different levels. With Germany mostly relying on "hierarchy-type" coordination (Level 1) with hardly any direct micro-management between the different units responsible for the concrete policies, the strategies' overall direction is, due to the department principle (Ressortprinzip), set top-down by the leading figures of the ministry for research (of course based on preparatory work of the ministerial staff) and approved by cabinet decision; during the runtime advisory support was provided from a high level committee: the Hightech Forum[26], consisting of representatives of research organizations, universities as well as industry. However, no regular consultation between agencies[27] and the high-level figures happened concerning the overall strategy and roll out of measures; hence single ministry units, responsible for specific policies, would consult their agency as the "administrative arm" on a regular basis.

[26] https://www.hightech-forum.de/en/about-high-tech-forum/ last access 27.11. 2023

[27] In some cases, agency employees are also called as legal consultants or strategic advisors, however, the working relationship between most agencies and ministries in Germany is not (intended to be) at eye level and the strategic decision making authority of most agencies is much stronger in UK and Sweden.

The situation in the UK and Sweden is quite different. In the case of UK, a kind of "super ministry approach" was in place at the time with a view to genuine knowledge related policies and STI support: "*Compared to many other countries I think in some ways the coordination situation has been easier in the UK because BEIS is such a big department. It has all the university funding, it has skills funding, it has challenge-led funding, it has industrial policy." (UK_6: 82) With the involvement of powerful, independent agencies such as the TSB ("Creating an independent national body [NB: TSB] to support business innovation, I think was a very good thing". UK_6: 70), t*he UK show a mix of Level 2 and 3 coordination workflows.

As already outlined above, the Swedish case is an example of strong and independent Level 3 coordination after negotiations by Level 1 (high-level of cabinet) and 2 (high-level of ministries) have been finished and comprehensive meta-guidance was given (strategy document). In other words: once the priorities have been clearly expressed by policymakers, employing a robust independent agency like Vinnova, which oversees operationalizing the strategy, can serve to "depoliticize" or deconflict the policy domain while formulating and implementing the strategies instruments:

> *"[…] the minister of enterprise said: 'No, no, no.' We won`t point out anything because we let the experts at the agency do it." (SWE_3: 91).*
>
> *"So, we are given those more general goals for the national strategy, we [at Vinnova] then formulated our own goals so to say, more related to specific areas or more related to specific measures. So, e.g., it could be some goals around public procurement […]. So, we are trying to find ways to break down the more general goals and the more specific ones and link activities to those internal goals within Vinnova. "(SWE_6: 29).*
>
> *"The minister of enterprise is representing one party, the minister of education the other one. And in that you see that you have kind of fundamental different views on how things go towards innovation. Therefore, we do have a clash of sides, which makes it hard to deal with. I mean it`s not easy to solve for us at the ministry: so, employing an agency certainly brings progress and things forward." (SWE_1: 80).*

In addition to the identification of the involved levels of coordination, a more qualitative categorisation on the – simply speaking – corresponding work flow towards policy action has been coined: the differentiation of negative and positive coordination, as well as policy integration and strategic coordination, see Figure 4 for definitions (Braun 2008) and proposed localisation of the cases. Whereas UK and Sweden show meandering routines of positive coordination and policy integration, the clearest assignment of one single mode was negative coordination in Germany, according to the answers provided, contrasting the official strategy document. Even though Edler et al. called the German routine "cooperation within fragmentation" and have identified "a communication process […] [as a] new means of coordination, as it creates inter-ministerial transparency and reduces transaction costs," between the central ministries during the formulation of the first Hightech-Strategy, proposing to "interpreted [it] as an attempt to coordinate through common strategy building across fragmented policy areas ('soft' external coordination) initiated at cabinet level and supported by advisory bodies," (Edler et al. 2008, p. 271), the empirical material allows to draw the conclusion that this high-level attempt has not pushed towards a constructive forward looking routine but rather the manifestation of tradition trench wars.

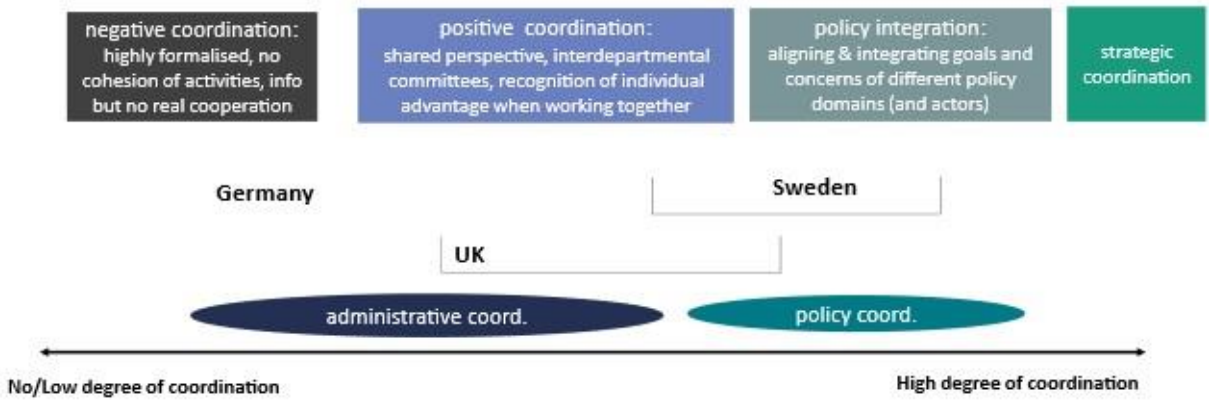
A central forum has been installed with the inter-ministerial committee (interministerieller Ausschuss IMA), meeting two to four times each year, with representatives of each ministry*"[…] a so-called research officer since 1976. This research officer, who is responsible for coordinating the R&D area for the respective ministry, is always reappointed by cabinet decision." (GER_8, Pos. 5).*

Despite a few individuals emphasizing good working relationships on an informal level (see first bullet point below) the general spirit was described as conflictual and non-cooperative: thirty-one single statements about negative coordination and counterproductive rivalry between political entities have been made by the 17 German interview partners. Representative illustrative examples read as follows:

> *"You are most likely to be successful if not too many players are involved. That's why there is a tendency in every ministry to deal with issues on a stand-alone basis, then you can control everything to some extent and know your routines. […] [If you need to interact] the classic way of doing business in the federal government is negative coordination, the lowest common denominator survives." (GER_11: 29_41).*
>
> *"Systemic policy making for real change fails due to practical and institutional problems: a good proposal that comes from the opposition is always bad. That's the game in politics. If we receive a proposal from the opposition in the committees where we currently sit as government representatives, of course we cannot say that the opposition's proposal is good. Even if we are convinced that it is […] but the leadership of our ministry would slap us in the face if we would support this statement." (GER_5: 70).*
>
> *"This dispute is constantly smouldering, and people are keeping a close eye on who gets which topic and budget and who must go to the gallows, so to speak, if things go wrong. And this dispute runs through many topics [of the strategy]." (GER_8: 38).*
>
> *"And the strategy [metaphorically] makes this claim about coordination and says: "People, this can only work if you all feed your contribution into this strategy. Only then will it become a meaningful whole. […] the entire federal government does not lack the basic understanding that the strategy is a meaningful thing, but when it comes to the actual work, the dispute usually starts. […] These are not strategic considerations but obvious power games." (GER_12: 51_54).*

In addition to the strong departmental principle (Ressortprinzip, Art.65, 2 of the German constitution), which was established in order to structure the departmental budgets and to avoid contradictory action by a clear division of responsibility, the rather drastic statements reveal that the first two generations of the Hightech Strategy were characterized by challenging cross-ministerial processes. As respondents noted, "*cooperation in demarcation*" might not necessarily be a bad thing, since this can be beneficial for decision making. However, against the background of systemic solutions necessary for GC or mission-oriented strategies seems to hamper or even hinder transformative policy making.

Figure 4: Simplified overview modes of cooperation[28]



Furthermore, the following (more pragmatic) aspects were associated with supporting policy strategy practise and coordination in general:

- **Proximity and direct, informal contacts on working level are crucial:**

  "And proximity matters: the TSB and the research councils were all based in the same hemisphere or building sector in Swindon and Camden/ London. And there were monthly get togethers plus a multitude of personal exchange of the people who work for the research councils and TSB, and they trust each other." (UK_1: 54).

  "The Swedish government offices are quite a small organization. We work within ten blocks or buildings from another and we always work quite tightly together between the different ministries." (SWE_13: 28).

  "Basically, a lot of things run informal; […] I have good contacts with colleagues at the other ministry. Cooperation is basically based on very intensive personal dialogue. The informal aspect, e.g., conversations over lunch, that is actually the crucial factor." (GER_4: 25).

- **Strategy work and coordination needs prudence and long-term commitment**

  "We are definitely in an exciting phase of putting the best people together with a significant budget around a joint strategy. We need sturdiness and patience. I mean it might sound more perfect than it actually is, it`s quite messy, but again that is quite often where innovation comes from." (UK_9: 49).

  "In any system this [better coordination] will be an ongoing project. It not likely that suddenly the system is coherent and integrated. In any system that`s always work in progress which is dynamic to the system- it`s always changing and developing." (UK_11: 25).

[28] Source: Adopted from Braun 2008, p. 231 and Lindner 2012, p. 276 with insights from Bouckaert et al. 2010; Peters 2006; Tosun et al. 2017.

> *"[…] coordination is the most important thing; it`s a huge challenge still. And we need to take it, everyone intends to call for quick fixes (…), but the courage to act towards a more integrated view is essential today."* (SWE_15: 89).

- **Teaming up in cash-strapped times or positive cooperation by incentives**

> *"Well, the main incentive now for better coordination is if the finance ministry cuts the benefits, that`s then the driver which encourages coordination between government departments because you need a partner." (UK_3: 109).*

> *"We have tried to connect everything as much as possible since we are small […] we work with the Innovation Strategy, with Horizon 2020, try to integrate many things and resources […] we work very close together." (SWE_16: 100).*

> *"It can work […] if sufficient participation is assured and practised, so that the other departments also see that there is some benefit for them, not only in terms of honor and reputation, but also in terms of resources." (GER_11: 14).*

- **Combining STI strategies with more regulation can encourage change (see also next chapter)**

> *"You can see that some of the constellations are working with a broad set of actors: with companies, with supplies, with academics, with users, with customers and those who put the requirements in practice like regulatory actors. Because the latter is essential if you want to change society." (SWE_7: 27).*

> *"The state should regulate more, of course. If you really have a strategy, you have to do more than just say that we want to promote environmental technologies. The state should actively promote environmental technologies, from basic research to diffusion into the market, and then actively implement the findings." (GER_16: 26.)*

4.4 Capacities for (strategic) policy making

Particularly the role and purpose of public organizations capacity to foster change has gained a lot of scholarly attention over the past decade (Borrás 2011; Wu et al. 2017). About ten-15 years ago policy analysis seemed more focused on the observation of modes and routines of policy learning (Biegelbauer 2013), described in concepts like government-learning and lesson-drawing (Etheredge et al. 1983; Lorentzen 2009; Rose 1993), policy-oriented learning (Bennett et al. 1992; Sabatier 1987), and the more fundamental reflexive-strategic learning (Bandelow 1999). The following pragmatic definition of policy learning offered by Koschatzky and Stahlecker, based on an analysis of attempts to align regional innovation- and EU-cohesion policy, illustrates why the term works on a meta-level, but falls short of capturing the practice among policymakers and shapers involved in national innovation strategies:

> *"Policy learning includes […] the creation and absorption of new knowledge among those who are responsible for political decision making, forgetting of past routines when necessary and the understanding of new opportunities which new policy options offer. In this way it is related to professional expertise and proficiency in policy skills. As the innovation itself, learning is a cumulative process (Lundvall 1992). Policy learning is thus based on already acquired competences and experiences in learning." (Koschatzky et al. 2009, p. 10).*

Today the practical and scholarly debate on individual and collective policy actors' abilities seems much more differentiated and shifted heavily towards the more comprehensive concept of capacity which broadly refers to "[…] the ability to perform functions, solve problems, and set and achieve objectives" (Fukuda-Parr et al. 2002, p. 8) from societal to institutional and individual levels." (van Kerkhoff et al. 2015, p. 13). It is remarkably "transformative capacity of public sector organizations", that should provide practical policy guidance and, according to Borrás et al. (2023), could be subdivided into the three elements of roles, skills and resources that public organizations can activate and provide for the policy process (Borrás et al. 2023, p. 14). This ties in with the argument put forward by policy advisors as well as scholars: the need for more reflexive governance (Lindner et al. 2016; Voß et al. 2006) to handle complex and 'wicked' problems with suitable policy mixes (e.g. MOIP, sustainable development), which calls for more "dynamic capabilities" within the public sector:

> *"Indeed, we can argue that today innovation policy landscape is in something of a cognitive paralysis: governments increasingly realize the "wicked" nature of some of the most pressing problems they face and at the same time also realizing that existing policy toolboxes (of design, coordination, and evaluation) are not enough to tackle these challenges. In other words, governments increasingly recognize that they need more dynamic toolkit – capabilities – at their disposal." (Kattel et al. 2018, p. 790).*

The latter observation summarizes the question guiding this chapter: Does the formulation and implementation of the national innovation strategy require specific "strategic" skills from the actors, and if so, what are they?

Generally, two thirds of all respondents agreed that different strategic skills and capacities are needed in the context of national innovation policy strategies by public actors. Twenty-nine interviewees further elaborated on their personal policy practise. Figure 5 shows the clustered sub-categories of their answers and their frequencies.

Figure 5: Sub-categories of strategic capacities

Clearly the answers displayed in the following chapter all concern individual abilities, but of course they also symbolize the entity (ministry, agencies etc.) in the need for e.g., more "*Willingness for policy experiments"*: one UK policy implementer, for instance, outlined the importance of experimenting with new instruments while simultaneously acknowledging the willingness of learning by understanding and tracking impact:

> *"We are keen to expand the sort of experimentation within innovation policy as a way of kind of really improving quality …]. We are going to spend more time with tracking the trends and looking at how it [NB: accelerator program for start-ups from the US]*

> *is unfolding and trying to understand this in more detail to really work out what the impact has been. You know in our [policy] businesses buzz words travel a lot quicker than evidence does." (UK_11, Pos. 72).*

The following quote by a German respondent serves as a combined answer to both aspects guiding this chapter: she offers examples of needed skills (e.g., analytical thinking), but also points to the fact that real strategy and directionality in policy making cannot be driven on the side: it needs real expertise, authority, and commitment:

> *"It requires strategic skills, some of which are no longer available. I'm quite honest about that. Firstly, it requires clear analytical thinking. It requires networked thinking. It requires special communication and teamwork skills. We urgently need a strategy unit – every unit does, but especially in the Federal Ministry – that is headed by someone who can really drive in this direction and whose colleagues are suitably qualified. Firstly, they need the expertise and authority and secondly, they need to be able to utilise their working hours accordingly." (GER_15: 78).*

Furthermore, two representatives of Vinnova share their view on the importance for an *understanding of transformative potential* of a program (first quote) and its practical implications for choosing projects for funding (second quote):

> *"I think it`s essential that you do formulate your goals [concerning GC]. Then it`s important to formulate an impact logic and much more clearly what sort of things you want to achieve but then to step away from it and see: do I need to rethink this?" (SWE_12:58).*

> *"It's a certain wisdom or capacity we must have. It´s crucial when looking at a proposal `is the general idea driven by a societal challenge rather than something ordinary just addressed with new words´. I think that we`ve seen a lot of the latter in terms of proposals. But they are a different kind of project to run and that requires that we have a different understanding of how to evaluate and support this kind of projects." (SWE_7: 69).*

Hence contributing to a national strategy and its goals by aligning funding programs and the criteria for the review of proposals with the narratives of societal goals in alignment with scientific, technological and/or entrepreneurial ones is a complex undertaking. And of course, this challenge is not limited to (ex-ante) assumptions about the potential contribution of programs and projects but needs formative assessment along the way. A British ministerial representative mentions that up-to-date **evaluation skills and knowledge** on how to assess and understand impact beyond the classic canon of science indicators in the departments is crucial: "[...] *before you develop a program you have to set out your evaluation plan. So, would we like more qualifications of employees in departments to understand this? Yes, I think yes." (UK_3: 129)*

Predominantly British respondents (every third) stressed the **importance of monitoring and evaluation** throughout the interviews in general and clearly outlined, that a robust evidence base on outcome, effects and impact is an important pillar of UK policy making. The inhouse expertise in departments as well as agencies for crafting and documenting indicators to estimate numerical effects was mentioned by six respondents. If this has a direct effect on adjusting and improving

policy instruments, however, was not sufficiently answered. Generally, the routines for analysis and evaluation are well established though, since

> *"In the UK we`ve got reviews every 2 years, [which means] the government studies and gets policy reviewed. Then we are going through the objectives that should have been delivered and track progress. You look at change and you look at the objectives, because clear objectives are the best way for organizations to coordinate [themselves]." (UK_18, Pos. 30).*

In addition, a strong case was made by emphasizing that GC or mission orientation needs to be connected to the absolute necessities for driving innovation to unleash its potential for change. To do so, four respondents identified **practical systemic policy knowledge paired with domain and market expertise** as a prerequisite to craft suitable research and innovation policies and provide support during the implementation phase to give "real life advise", here is one representative quote by an agency employee:

> *"So, before drafting a policy we spent all of our time on the road listening to people, reading about specifics. There is no use of only reading books about how innovation is going, you have to understand the specific markets, the specific customers in the market and specific manufacturing capabilities of who will answer to those needs and connect all of this with the political ambition." (UK_5: 108).*

In fact, this hands-on attitude is articulated by most British interview partners and is also quite dominant within the group of Swedish experts.

Like the abovementioned perspective, the following two quotes are characteristic examples of this mentality as well as an indicator for another set of strategic abilities needed for current policy making that first and foremost aims at rebalancing the economy and speeding up commercialization in the UK, namely ***a spirit of optimism, business like mindset & business knowledge*** (reflecting the "liberal market economy" categorisation of UK on market mechanisms and abilities of companies)*:*

> *"Most important are people willing to learn. I have a team of people [at the agency] they are mostly on the road and within companies listening to people. If you open a meeting and say, I will be interested in your ideas? It needs people to take this opportunity. Are you on it? You need experienced practitioners, not a bunch of economists who are next to useless." (UK_5: 109).*

> *"The organization we set up [NB: TSB] and the people we recruited from business to carry out the policies, that is quite crucial; we were having conversations with businesses and for those we needed people from businesses." (UK_7: 48).*

At this point an observation needs to be expressed that is not only relevant in the context of capacity: In the German case only representatives of ministries were interviewed that, more often than not, seem to lack the practical view on policy implementation and therefore did not contribute as much to this chapter as the other two cases. This is undoubtedly a regrettable shortcoming of the author. At the time though, many ministerial interview partners indicated that the German agencies ("Projektträger") were not essential players, since they only had to "follow orders"; in fact, they have been described as the "administrative arm" or even "dorsal horse of ministries" by some. In retrospect this somewhat elitist ministry centred practise seems unfit to deal with the challenging requirements of the aspired influence for transformative change by national STI strategies and the

underlying policy instruments: the "translation" of the strategies' concepts, starting with the comprehension of how to turn the (theoretical) underpinning of GC or mission orientation into workable concepts beyond policy headlines – like "fighting cancer"- seems to be "in good hands" of policy practitioners accountable for funding, that not only carry the administrative burden, but also the design of the content and direction of the instruments. Particularly Sweden, has made notable efforts to de-conflict and de-politicize the policy area of STI by appointing agencies that are responsible for the entire policy life cycle. Particularly with a view to innovation policy, separating party politics from this policy domain in UK is even pursued as a goal, within the national strategy:

> *"And that was kind of the centrepiece of the strategy that came out. It was a direction of travel, so to say: „It`s important we separate the role of government from, you know, what we want to achieve for innovation and technology." (UK_12: 18).*

The current debate in Germany on mission agencies and change agents (Jackwerth-Rice et al. 2023; Lindner et al. 2022) and the establishment of new actors[29] can be interpreted as an acknowledgement of this institutional gap or missing competence and responsibility in this respect, which is reflected in the empirical material of this contribution.

A "very" German topic though is the changing role of (citizen) participation, a significant pillar of all three national innovation strategies. It was emphasized in the conversations on capacity as an unresolved challenge, ranging from practical realisation to the concern of manifesting a democracy deficit by overhearing the "broad masses":

> *"This [participation of civil society] will certainly keep us busy for many years because there is no longer THE group that perhaps pursues different interests, but the range of interests is so diverse. In other words, we should not see it as a coordination process, because then we will never be finished. It really is a dialogue, a communication process." (GER_15: 35).*

> *"I really do see a serious problem here because, ultimately, there is still no modus vivendi as to how the necessary infrastructure for innovation in our country, taking into account the diverse interests of citizens and other social groups, should be organised to be able to get anything at all off the ground, I think there is still a relative lack of imagination at the moment." (GER_13: 69).*

> *"So, is there a commitment that goes beyond clicking on "I like" and "I don't like"? this is a question that I am currently asking myself. This goes hand in hand with the question of which formats we would need for this. Quite frankly, we do not know how we could integrate this even better into the Hightech-Strategy and develop this strand of participation even better. In this respect, I personally am not yet sure whether I find this generally promising or whether such a willingness will also slacken as soon as you demand a little more time commitment from people. The question is, of course, do I end up generating a circle whose opinion is then seen as representative, and the broad masses are not heard?" (GER_12: 19).*

With a view to the cooperative active inclusion of professional stakeholder groups and networks (not the public) into topic-specific policy debates, positive influence of broadening the perspective

[29] E.g., SPRIND: Federal agency for disruptive innovation: https://www.sprind.org/en/ last access 22.11.2023

and possibly the constructive potential and usage of measures have been shared and exemplify the often called for "holistic approach":

> *"Then you must include the medical professionals, the care providers, the funders of this service and perhaps some other governmental agency, the medical modern health [facilities] and some other key stakeholders to build knowledge around this. You increase the potential of the usage by thinking about implementing it." (SWE_6: 54).*

> *"This means taking a holistic approach to safety and security technology as well. This included the topic of security in soccer stadiums. We sat down with the Red Cross, the technical assistance service, etc. These players have never been involved in an innovation or technology policy measure, let alone sat at the table." (GER_11: 14).*

Routines of **policy learning** were also mentioned by seven individuals. Nonetheless, these observations referred to the apparent element of "gaining more knowledge" and therefore provide no real added value to the debate. In summary, the answers concerning capacity and strategic skills point to the observation that it is about **skilful motivated individuals with authority to act in the public service** (as well as research and industry) working collectively for the common good:

> *"I am a big believer in people: good things will happen if you just get the right people into the right place and then give them power and money to get on to it." (UK_9: 45).*

> *"It's not about the document […] the strategy work for me: it's a bunch of people wanting to achieve something together: where we have to start with creating a common understanding on the language that we use and on who we are, that will do this together." (SWE_15: 119).*

4.5 Perceived obstacles for (impactful) strategies and most urgent systemic challenges

Generally, around one-third of interviewees were doubting if comprehensive national strategies, with their mix of instruments and narratives, are the right tool to increase the impact of STI policies, and some individuals were even doubting the effects of support instruments altogether. It is not surprising that the larger the distance of the interviewee from the inner circle of policymakers responsible for the strategies' instruments and decisions, the more substantial the doubts brought forward about the effects of the strategies. However, even some policymakers from the core group of responsible decision-makers stress the **limits of policy impact** (or even the insignificance of policies for substantial change) in a very blunt way, illustrated by the following example:

> *"[..] but the point is: the best projects we have done have a return rate of forty cents per pound. If you take the XX projects budget that is about 440 million pounds a year and you get forty cents back, for the one pound you`ve spent, then you actually generate something like point 1 of percent of GDP. Overall, that`s nothing. If everything we did is as good as the best things we did, you still would make no real difference." (UK_5, Pos. 76).*

British public servants representing different Ministries were furthermore very outspoken about lacking domain-specific expertise by politicians (parliamentarians and ministers alike) and were

missing **a modest perspective on and expectation management** about content, complexity and pace of change that STI policies might deliver:

> *"Politicians are happy to commit money, but they are not coming to see what is happening, and that is something quite hard to deliver when you are talking about programs where you solve complex problems or fund research projects where you are cutting edge. We have problems in managing the expectations of some ministers." (UK_1, Pos. 46).*

> *"Government, certainly in the UK, is a simplifier. And it cannot cope with the complex. We actually have complexity for a reason or for several reasons. And I think there are moments when it is overtly desired to reduce the complexity." (UK_4, Pos. 54).*

> *"There is an artificial split between science and research and innovation and research. And if we go back to the point, we`ve had earlier about "do politicians understand business, the answer is: they don`t. Another question is, do the politicians understand science? And again, the answer is no." (UK_5: 72).*

Strong statements were also made about the **exaggerated expectations towards STI policy as a fix for societal challenges** in general, backed through a tendency for symbolic policy by superelevation and rhetoric politics; this has been observed by representatives of every country case, e.g. "*I have difficulties to see how we want to achieve this. It`s lots of nice words but how to do it, how to do it?" (SWE_3, Pos. 10);* a German voice *"we always formulate lofty goals and beautiful headlines, but not too much happens." (GER_9, Pos. 32),* accordingly, a British interviewee states: "*The problem is really that the strategy is not big enough for the comprehensive change we announce" (UK_10, Pos. 132).*

Thus, criticism towards (policy) communication that presents the outcome of research as a global remedy has been voiced, as well. This **overload of the policy domain and science and research itself** is expressed by a British agency representative "*It`s part of our job to say: research is a risk bearer for society." (UK_4, Pos. 40)* She moreover sees a pattern of blame shifting or responsibility avoidance by (society and) government, neglecting the impact for fundamental change through an adequate policy mix including state-led regulation beyond STI advancements, e.g., with a view to a comprehensive ban on non-recyclable plastic or behavioural (societal) change regarding e.g., consumption patterns.

Besides the normative influence towards change, the impetus for innovation driven by regulation is missed by some, as this statement illustrates: "*Regulation, whether it is ecological or consumer protection-driven, is far too preoccupied with immanent issues and is not linked to the impulses for innovation that can be triggered by regulation." (GER_11, 68).*

This observation ties in with the argument that only "*the market is the driver [of real change]* "*(UK_7, Pos. 16)* brought forward by an agency representative, furthermore advocating for a constant dialogue with companies and society about the possible direction of change (or even systemic transformations) by consensually negotiated **regulation and standardisation** that set a reliable framework for decisions: "*because only if we have these standards (e.g. in energy efficiency) will entrepreneurs or investors in general know, that it is worth investing in this or that technology or product." (GER_16: 55).*

As already pointed out in Chapter 4.2, the ideational drivers for STI policy have become more complex, and the systemic and mission-oriented claim imposing directionality per se is questioned by policymakers, as this representative statement by a Swedish ministerial discloses: *"Where should the government*

put its forces on? We can't do it the soviet way, force sectors towards "this is where innovation happens". I always said it`s something strange getting direction into this policy area." (SWE_3, Pos. 72).

Collectively, eight major aspects were mentioned as neglected areas or missing elements in the interview partners' perceptions[30]. Interestingly, around ten years after the interviews were held, today, the national policy debates in some cases are still dominated by the aspects that have been raised as the "most pressing ones": Thereby, German respondents were mostly concerned with a missing focus "on sustainability & energy supply" since seven of nine voices raised these aspects. Today, the challenging rollout of the "Energie- und Wärmewende" (the concept-forming neologism of a broad energy systems transition including shifting resources and changing societal and individual demand) is one of the most pressing political challenge and controversial policy topic in Germany.

On the other hand, the majority (six out of eight) of the voices pointing out a missing "activation of capital & investment by businesses "are British. And indeed, the UK is still struggling today to re-balance their economy and strengthen the ties between science and industry. Regarding the historical context of the interview phase (March 2013-April 2014), another striking observation is the EU scepticism that was expressed by half of the British interview partners. The Brexit referendum was held only around two years after the interviews in 2016, and the exit of UK from the European Union was finalized in January 2020 (concessions in research and innovation-related policies, e.g., within Horizon Europe, were successfully negotiated afterwards). Additional major focus aspects are the following, which are backed with representative quotations in Figure 6. Apart from pointing out individual knowledge gaps on the one hand, systemic shortcomings are emphasized on the other hand, that would need to be addressed in national multi-level governance settings across government, ministerial hierarchies, and the involved addressees (e.g., industry, universities, research organizations) as well as in cooperation with the implementers and evaluators at agencies:

- missing interaction, transfer science towards industry (8),
- missing link regulation & frameworks directing innovation (6),
- missing skills & work force plus career options for scientists (5),
- missing understanding of SMEs needs (5),
- missing consistency, scale, direction (5),
- missing holistic practise & coordination (5).

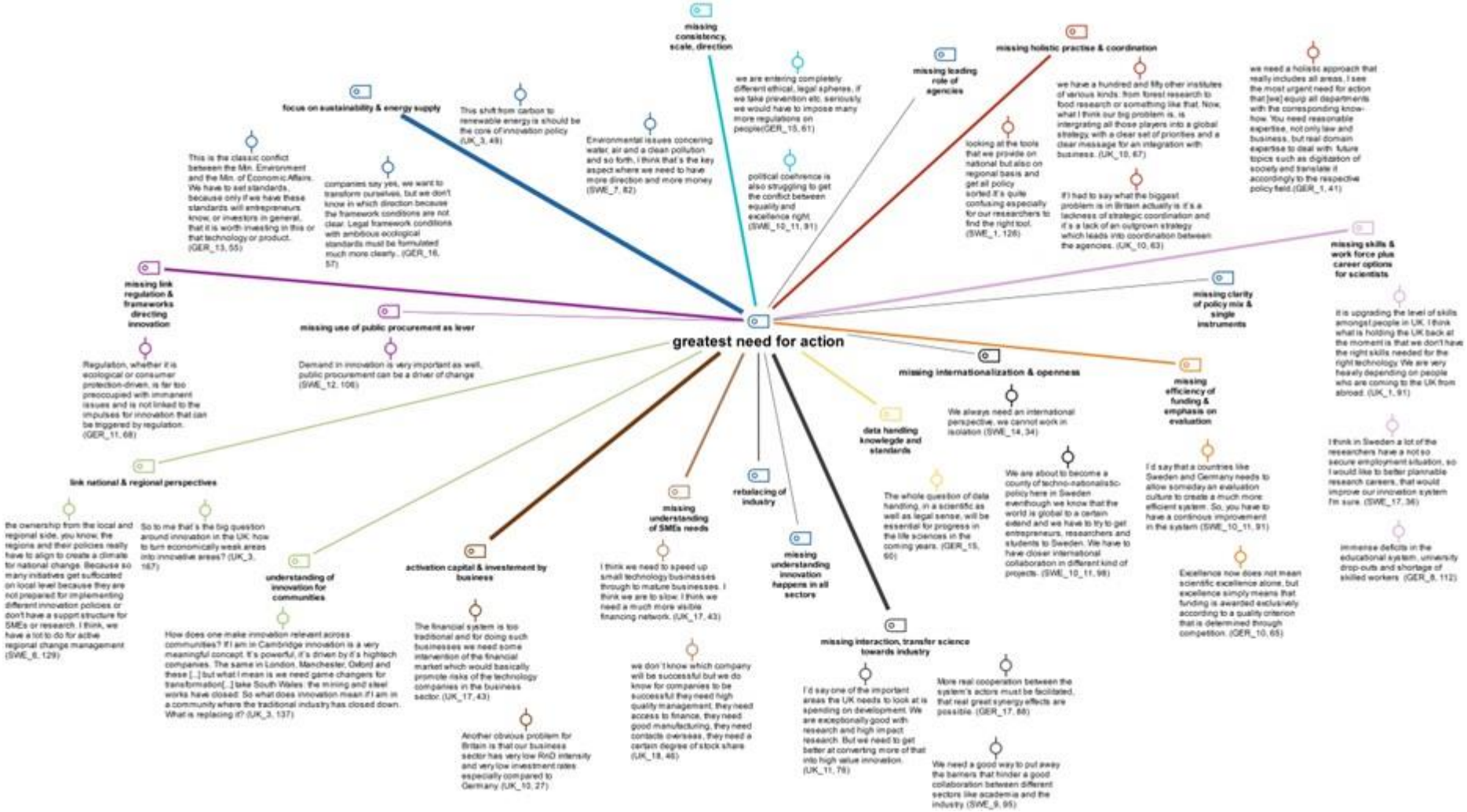
More individual views were put forward regarding "Missing data handling knowledge and standards" (4), "missing efficiency of funding and emphasis on evaluation" (4), "missing links between national and regional perspectives" (3), as well as "missing internationalization and openness", an aspect that two Swedish respondents worried about. With a view to the core ambition of GC, mission-orientation, and strategy – in simple terms: all comprehensive and systemic approaches that aim at changing socio-technical systems for good, not only targeting "quick wins" – systemic shortcomings were identified as missing or underrepresented: consistency, scale, direction, coordination, holistic practices.

All these factors have been dominating the debate of political science and other academic disciplines for the past decade and are core research desiderata that need empirical investigation and validation of the STI policy studies community: a more intersectoral debate on the design of the corresponding policy instruments and the challenges or even barriers of implementation plus an honest account of associated misconception of the effectiveness of such policies and strategies is needed.

[30] Based on the question "What do you see as the most urgent challenge in innovation policy?" Aspects that have been mentioned around 5 times have been selected as key concerns.

In addition, the arguments about the lack of individual skills such analytical and methodological knowledge as well as missing domain and system expertise point out that civil servants need a different skill set today, that is up to date with the current policy dynamics. In this respect more education and training in cross thematical, strategy relevant aspects are needed and only if the different levels, responsible for STI strategies, engage in an honest, solution orientated and formative dialogue necessary policies for the necessary change can be realised.

Figure 6: Missing elements or needs for policy action mentioned by interviewees



5 Main findings and further avenues for research

The key interest of this contribution was to shed light on the question: what kind of phenomena are national STI strategies? Since several western countries introduced national STI policy strategies in the mid-2000s, this question had not been addressed by political science yet. Clearly, according to the official wording they are motivated by the desire to expand the impact of the STI policy domain towards contributing to solutions for *grand challenges* in addition to the initial assignment of increasing technological progress and economic prosperity.

Nevertheless, as this empirical prestudy[31] (Swedberg, 2012) revealed, they serve several different but also shared purposes: regarding the latter, all documents aim to shift the focus from technology push to societal demand driven actions and try to enhance participation to broaden the stakeholder base (e.g., interested citizens, patient groups, students, regional industry networks) in general. With regard to the identified differences between the strategies investigated, the following "pitches" summarize the key differentiating characteristics:

- **The Grand Gesture**: Germany clings to delineation as cooperation: even though holistic narratives are used and high level committed is expressed, solitary action by departments seems to prevail
- **The Grand Growth**: struggling with its financial sector at the time, the UK puts its emphasis on creating and shaping markets through tech transfer and providing evidence analyses, new entities, such as the TSB, were created for this assignment
- **The Grand Grid**: for Sweden, regional participation and networks are key aspects and fostering innovative public sector procurement; in combination with an impactful national agency such as Vinnova span a net to carry the strategy

The circumstances of the introduction of the strategies also differ to some extent and were routed in institutional reforms paired with personal engagement by the political leadership (Germany), the hope to rebalance the economy by closer engaging with industrial partners and help to reduce time to market of new products and process innovations (UK) and the chance to take on a new and improved approach to innovative public procurement while aligning regional with national levels of policy making. Table 3 describes the strategies on a comprehensive level.

[31] on national R&I policy strategies drawing on original qualitative work showcasing the German, UK and Swedish strategies during the period 2006-2014

Table 3: Comprehensive overview of strategies and take aways

	Germany	**UK**	**Sweden**
"Pitch"	**The Grand Gesture**: delineation as cooperation: holistic narratives but singular actions?	**The Grand Growth:** creating & shaping markets through tech transfer and evidence analysis?	**The Grand Grid:** regional participation and public sector procurement as an effective net?
Top priority	• mobilizing more R&D investment by industry in key technologies • more engagement in social dialogue	• fostering tech transfer • speeding up commercialisation process	• regional networks to create ownership across the country • innovative public procurement.
Top instrument	• forward-looking projects (similar to missions) • improving the general conditions for start-ups, SME and venture capital	• more responsibility, budget and personnel for the Technology Strategy Board (TSB) • initiation of Catapult centers[32] (as intermediary actors)	• reorganization of Vinnova; • setup of cross-institutional challenge-led program (competitive three stage project funding.
Distinguishing feature	• strong department responsibilities (editorial process as coordination) • agencies as administrative arms of ministries	• role of monitoring was emphasized • a triad of public servants for finance, planning and analysis in place in each department unit	• agencies oversee budget and content • regional engagement important
Summarizing quote	*"We are moving from a supply-orientation to a demand-orientation. This approach is also reflected in the key areas and, for example, in our new foresight process. We are clearly approaching topics from the social perspective and no longer from technology push." (Ger_12:47)*	"*We [the UK] are one of the leading science performance countries in the world […]. Because we have a very strong university-based science system, we have the big problem of how this should be interacting with the strong industrial performance.*" (UK_10: 23)	"[…] after the prime ministers' announcements, we decided the process should be open for all partners of societies […]. We work with regional network partnerships […] I'd say they are nexuses for the change processes." *(SWE_15: 6; 39)*

[32] "Catapults are physical centres with a unique combination of cutting-edge R&D facilities and world class technical expertise. There are nine Catapults, working in over fifty locations, in every region and nation of the UK", see https://catapult.org.uk/about-us/our-centres/ last access 16.11.2023

A general challenge mentioned by all groups of interview partners was the shortage of skilled labour with the relevant expertise in technological and digital sectors. With a view to the demographic change in the countries studied, this problem potentially only got worse. Surely since the empirical material was gathered around two legislative periods passed by and new national strategies were published and implemented (see the overview in Figure 1). So, the question is valid if the aspects raised in this empirical contribution have not been solved by now?

Of course, it is difficult to judge real progress or development from the interviewees point of view without revisiting them or collecting similar material. Still, some encounters and document insights provide for very few selected signs towards a different understanding of an important part of strategies: missions and MOIP. With a view to UK for instance, missions have been established as a vital part of the national policy agenda and the observed formative monitoring practises have even been translated further into the delivery plans of each mission as well as elaborate attempts on "co-creation, co-delivery and co-evaluation of missions with industry and citizens" (Hufnagl et al. 2019, p. 3).

Furthermore, Vinnova cultivated the methodological toolbox (Hill 2022) and also put more emphasis on its' challenge-led program. Germany experienced a period of prominent mission wording (with some attempts of MOIP design and implementation) with the last two generations of the Hightech Strategy (BMBF 2014, 2019) but did not fully live up to the expectations of the scholarly community working on the MOIP concept with regard to coordination: "Cooperation and coordination are often complicated by interdepartmental competition. There was little evidence that missions facilitate positive exchange between different ministries going beyond a delineation of responsibilities and negative coordination. Overall, frequency and intensity of inter-ministerial or trans-ministerial activities appear to be relatively low." (Roth et al. 2021, p.VI) The current *Future Strategy* seems to downgrade the mission concept further by formulating unspecific sub-headlines (e.g., Developing modern technologies for a competitive, circular and climate-neutral industry) to overarching „transformation processes" such as "Enabling a resource-efficient and circular economy-oriented competitive industry as well as sustainable mobility" (BMBF 2023b, 35ff).

Further avenues for research

Since this contribution was focussing on the national level a neglected aspect is the **interplay within multi-level governance settings** between the EU-level and the member states as well as in the federal system of Germany the interaction of the national state with the German Länder. With a view to the EU, however, a puzzling observation was that many interview partners were convinced that their country was THE agenda setter per se and could "direct" EU policies to best suit their country's interest.

The **importance of communication** in politics (e.g., targets, success, failure) and science communication in digital as well as traditional channels has grown since the investigation. But already ten years ago it was seen as a major task of the document to carry the message of urgent challenges: "*[…] we come to the core of an essential function of such an overarching strategy. That is communication. The communication and communicability of key social issues." (GER_8: 90)*

In that respect some respondents made the critical claim that the national strategies are simply not more than a communication tool of the government or insisted that the cross-departmental coordination and cooperation has sufficiently been achieved when the document was published, and the editorial process finalized. Further investigation on the **practical exchange and consensus seeking (coordination)** among the involved stakeholders and **public relations patterns regarding STI policy** and national strategies are needed. Particularly, since the STI domain is complex, and content is not easy to communicate ("*I mean as a politician research and innovation policy is nothing to get elected for. You would need to talk about schools. Talking about innovation, it`s nothing*

to win an election." (SWE_4: 37)). Insights on whether connecting STI policy to societal demands has "more appeal to the voter" is an exciting research desiderate.

Many interview partners, however, described this plea for linking STI policy to providing solutions to the grand challenges as a positive and motivating leitmotiv. However, the majority seems overwhelmed by this expectation due to several interconnected reasons. First, often a missing **concrete and consensual operationalizing of the contribution to the challenge solution,** that turns overwhelming headlines in concrete sector specific meaning as a basis for **workable concepts** (e.g., breaking down "climate change" to "inventing alternative emission-free mobility concepts" etc.) is criticized by some. Second, the need for new policy instruments and programs to support systemic transformation also calls for different **formative evaluation practises and indicators** to assess output and impact than before.

In conjunction with these observations another main lesson is the missing empirical as well as academic examination of how the community of actors responsible for strategy and policies, either in ministry or in agencies, learns from experience and if decision makers respond when objectives are not reached (or "simply" change the objectives)? The scholarly community has been very much focused on patterns of policy learning (see 4.2) but not on evaluating the results of these actions. Today, even some national strategies are referred to as "learning strategies", like the current German document for instance: "As a learning strategy, the Future Research and Innovation Strategy will respond quickly and flexibly to change. To this end, progress will be monitored on an ongoing business, experience contributed, and goals adjusted where necessary." (BMBF 2023a, p. 3).

Reacting to change is surely smart. However, what does this statement reveal in practice? Can actors of the STI system really rely on a formative support system by policy, based on professional monitoring practises? During the past generation of the Hightech-Strategy (BMBF 2019) scientific support was provided, but hardly any advice led to altering the policy practices so far (Wittmann et al. 2020; Wittmann et al. 2021c). Also, British respondents could only confirm that monitoring is happening, but not report if and how change based on analyses is initiated.

Therefore, more insights and empirical work is needed to reveal patterns of processes of changing policies to trace **if and how policy learning and counteracting is happening**.

This could furthermore help to gain insights on the methods and effectiveness of evidence-based policy advise for recalibrating policy instruments and help to close the gap – already mentioned in the introduction – between academic theory and policy practise little by little.

A.1 Description by category of innovation policy strategies in place 2013-2014

	Germany	UK	Sweden
Titel	*Ideas. Innovation. Prosperity.* *Hightech-Strategy 2020 for Germany (HTS)*	*Innovation and research strategy for growth*	*The Swedish Innovation Strategy*
Publication year	2010	2011	2012
Published by	Federal Ministry of Research and Education	Department for Business, Innovation and Skills	Swedish Ministry of Enterprise, Energy and Communications
Corresponding document	Action plan for Parliament (DS 17/9261)	Economics Paper: Inn. and Research Stra.	no explicit reference made
Agencies (with independent configuration of programs)	No: German Agencies (Projektträger) & Research Councils (e.g., DFG) are bound to their role of managing & administering project funding	Yes: TSB Driving Innovation (2011): Concept to Commercialisation A strategy for business innovation, 2011-2015 Establishment of Catapult Centers	Yes: E.g., Vinnova's Challenge-Driven Innovation program • Future Healthcare • Sustainable Attractive Cities • Information Society 3.0 • Competitive Production
Vision/target date	2020	This vision will not be realised immediately; it will take years of sustained investment and effort (…)	2020
Previous document	The Hightech Strategy for Germany (2006)	Innovation Nation White Paper (2008)	Innovative Sweden – A strategy for growth through renewal (2004)
Reference to EU or other policies	Yes, Horizon 2020 ("The Federal Government wants to extend	Horizon 2020.	Yes, Europe 2020, Horizon 2020, reference to urgent

	Germany	UK	Sweden
	the successful approach of the HTS to the rest of Europe."p.9)	Anglo-US Financing Innovation symposium in 2012	societal challenges (EU Comm 2010) (p.5) OECD 2010
Motivation - Justification - Aim	Individual fields of technology are seen as contributions to realizing important social policy aims or as innovation drivers for other fields of technology ("key technologies"), while social change is an essential prerequisite for the generation of technological knowledge. (p.4)	The Coalition Government is putting innovation and research at the heart of its growth agenda. Innovation is essential to competitiveness and higher living standards. Through more significant investment and increased collaboration, we will make sure that the UK has a promising future.	• Meet global societal challenges. • Increase competitiveness and create more jobs in a global knowledge economy. • Deliver public services with increased quality and efficiency (p.7)
Guiding Principles	The Federal Government's innovation policy activities are geared towards […] five fields of action, with the aim of tapping emerging markets. (p.5) Critical key technologies and measures to improve the general conditions for innovation will be funded to encourage new developments in […] five fields of action.	This strategy sets out the Government's approach to • boosting business investment in innovation and ensuring UK success in the global economy. • Universities and research, entrepreneurship, and risk taking, more significant connections between people and organisations, • a more open environment will all be at the heart of our approach. p.5	1. Best possible conditions for innovation 2. People, businesses and organisations that work systematically with innovation 3. Implementation of the strategy based on a holistic view p.21
Structure & Priorities	**Headlines and descriptions**, no process or milestones, general outline: • Focus on global challenges • Mission-oriented approach: Forward-looking projects • Key technologies • General conditions	**Headlines and listings** of planned initiatives, no process description: 1. Discovery and Development 2. Innovative Businesses 3. Knowlegde and Innovation 4. Global Collaboration 5. New Innovation Challenges	**Stating meta-targets e.g.** Innovative regions and environments **Goal:** Sweden's regional innovation environments have international appeal **Sub target:** Sweden's regions are increasing their innovation capacity based

	Germany	UK	Sweden
	Five fields of action (incl. "Lines of action" summarising planned or existing policies, strategies) ○ Climate & Energy ○ Health & Nutrition ○ Mobility ○ Security ○ Communication	➔ Emphasis on **Technology Strategy Board** as main independent agency for innovation ➔ Introduction of **Catapult Centers** as integrated approach that brigdes gap betw. academia and business ➔ Focus on **four emerging technologies**: Synthetic Biology, Energy-Efficient Computing, Energy Harvesting, Graphene	on their unique conditions **Sweden therefore needs to e.g.:** Develop collaboration between actors on different levels that strengthen the regional appeal, based on e.g., clusters and test and demonstration facilities where relevant. P.48
Monitoring	No mentioning of progress monitoring in document. Expert Commission for Research & Innovation (EFI) as independent advisory body appointed. Note on finances: The various measures of the HTS are financed within each Ministry's own operating budget. p.6	The complex nature of innovation and inter- actions within the innovation system means that monitoring progress in implementing the Strategy needs a **broad range of indicators**. We will report on the baseline for these commitments in the Annual Innovation Report 2012, which will be published early next year, and we will continue to monitor through NESTA's Innovation Index (p. 89 ff)	An effective way of monitoring initiatives is required to develop and adapt initiatives without compromising the long-term character and clarity of ambitions. […] To enable continuous learning, objectives that are possible to monitor over time, as well as good analyses for well-founded priorities are needed. p.52
Implementation	Outline of "Forward-looking projects for Parliament (HTS Aktions-plan, Drucksache 17/9261) • Intro to challenge e.g. climate change • **Project description** e.g. "renewable primary product alternatives to oil"	Our overall objective is to increase levels of innovation that drive growth and create jobs in all parts of the UK, and we need to demonstrate that we are delivering the programmes and initiatives set out in this strategy. The key milestones	The Government intends to present an overview of the implementation. As the implementation of the strategy is also a matter that concerns many actors in society, the Government also **intends**

	Germany	UK	Sweden
	• Tentative **goal description** e.g. strengthening the expansion of the bio-based economy • **Lines of action** for implementation (mostly research funding), contribution by diff. actors	are set out in the **delivery plan** (p.91-96)	**to report at regular intervals** on the development of the innovation climate in Sweden. p.51
Mission-like concepts	forward-looking projects, reference to stakeholder engagement (Drucksache 17/9261)	*challenge-led innovation and research programmes, often reference for need to economic exploitation*	*challenge-driven Inn. Program;* often references to societal challenges

A.2 Questionnaire addressing frameworks of policy making, practices and (strategy) capacities of actors regarding national innovation strategies of Germany, UK and Sweden

Opening questions:

Could you please define your role and the role of your unit/ministry/agency in the (strategizing and) implementation process of the national innovation strategy? (Further questions to "identify" the addressee, see last part of questionnaire)

Können Sie mir bitte Ihre persönliche Rolle und die Ihres Ministeriums/Referates in Bezug auf die Formulierung und Umsetzung der Hightech-Strategie beschreiben?

Why did the government decide to launch a national innovation policy strategy?

Warum hat die Regierung eine nationale Innovation-Strategie eingeführt?

Focus 1: Frameworks for policy making:

guiding principles and policy objectives of the strategy

The guiding principles of policy strategies can be identified as a major element of strategy altogether. As numerous studies have shown, the willingness to reach a certain goal is a key element and a driving force of strategies in business contexts or concerning military and defense operations as well as policies. Regarding the latter, one must remember that the aim to reach a certain policy goal seems to "tell only parts of the story". The policies are chosen, and their related instruments always reflect an inherent normativity that replicates the involved polity structure and reveals the current government's value system and its way of "doing politics".

Therefore, by asking about the guiding principles, I would like the respondent to reflect upon the underlying **values, norms,** and thus the **contextualization of the goals** that he or she associates with the innovation strategy and its instruments. The perception of the implementers should help to learn about the motivation/mission behind the strategy and the way in which abstract goals for instance "the Grand Challenges" serve as guideposts for actual policymaking.

Core interest: What are the guiding principles and policy objectives underlying the national strategy, and how are these perceived and actualized by the organization implementing the strategy?

Welche Leitlinien und politischen Zielsetzungen liegen der nationalen Innovationsstrategie zugrunde und wie werden diese von der für die Implementierung verantwortlichen Organisation verstanden und operationalisiert?

Main questions:

1.1. In your opinion, what are the guiding principles and policy objectives of the strategy?

Was sind Ihrer Meinung nach die Leitlinien und politischen Zielsetzungen der Hightech-Strategie?

1.2. What do you think are the main characteristics that turn policies into a strategy?

Does the innovation strategy fulfill these criteria?

Was sind für Sie die wichtigsten Kriterien einer strategischen Policy/politischen Strategie? Erfüllt die Hightech-Strategie diese Kriterien in Ihrer Wahrnehmung?

1.3. To what extent did introducing the national innovation strategy alter the innovation policy? Is the strategy addressing all actors relevant for innovation?

Wie hat sich die deutsche Innovationspolitik mit der Einführung der Hightech-Strategie gewandelt? Inwiefern addressiert die Strategie alle für Innovationen relevanten Akteure?

1.4. To what extent can specific objectives, like an orientation towards "solving the grand challenges of our time", provide added value (regarding the strategy)?

Inwieweit unterstützen Vorgaben wie die Orientierung an den "Lösungen der großen Herausforderungen unserer Zeit" die Zielerreichung der Hightech-Strategie?

Add on questions / weitere Fragen

- If challenge-led or mission-orientation was mentioned: How do you perceive and operationalized grand challenges as a guiding principle? Wie haben Sie die großen Herausforderungen als Leitprinzip verstanden und umgesetzt?
- How are the strategy objectives translated into policies/policy instruments? Can you give me an example? Wie werden die Zielvorstellungen in konkrete Policy-Instrumente übersetzt? Können Sie mir hierfür ein Beispiel nennen?
- In your opinion, are the targets of the strategy reasonably straight forward? Sind die Ziele der Hightech-Strategy Ihrer Meinung nach eindeutig formuliert?
- Do you see a conflict between setting up long-term policy strategies and short or mid-term policy planning? Sehen Sie einen Widerspruch zwischen der Etablierung langfristiger politischer Strategien und kurz- bis mitterfristiger Politikplanung?
- From your experience, can you describe the process of strategizing (setting up a policy that is strategic)? Können Sie mir aus Ihrer Erfahrung den Prozess der Strategiebildung erläutern?
- How were the policy objectives of the strategy selected and do you think that the priorities are suitable? Wie wurden die Zielsetzungen der Hightech-Strategie festgelegt und haben Sie das Gefühl, dass die richtigen Prioritäten gesetzt wurden?
- What is "strategic" about the current national innovation policy? Was ist Ihrer Meinung nach strategisch an der Hightech-Strategie?

Focus 2: Policy practices:Coordination and cooperation patterns of the strategy

The national innovation strategies of the UK, Sweden and Germany all pursue a "whole-of-government" approach, according to the respective *White Papers*. Among other aspects, this entails that the strategies are carried out by several ministries (or agencies) at the same time, engaging them in a collaborative effort. Consequently, the **implementation** of national strategies is bound to incorporate practices of **coordination and cooperation** between the actors involved. But what form do these practices take? How is the practice of implementation "achieved by various dynamic effects, such as decision making, communication, bargaining, negotiation, even conflict." (Schofield 2001: 254[33])

Core interest: How are national innovation strategies implemented and what kind of patterns can be identified regarding the coordination and cooperation of the actors involved?

Wie wird die Hightech-Strategie implementiert und welche Koordinations- und Kooperationsroutinen bzw. Muster zwischen den beteiligten Akteuren können identifiziert werden?

[33] Schofield, J. (2001): Time for a revival? Public Policy Implementation: a review of the literature and an agenda for future research, in: International Journal of Management Reviews, Vol. 3 Issue 3, pp. 245–263.

Main questions:

2.1. The national innovation strategy is presented as a combined effort of several ministries/units and a top priority of the current government. How do you coordinate your unit's actions and policies with other units/agencies?

Die Innovationsstrategie wird als gemeinsame Aufgabe verschiedener Ministerien und als wichtige Priorität der Bundesregierung präsentiert. Wie werden die verschiedenen Aufgaben zwischen den beteiligten Ministerien und Referaten koordiniert?

2.2. How regularly, and concerning which issues, do you cooperate with other ministries/units/agencies (contents of policies, targets, operationalization)?

Wie häufig kooperieren Sie mit anderen Referaten/Ministerien und bezüglich welcher Themen (Inhalte, Ziele, Umsetzungsvorschläge)?

2.3. How do the goals of the national strategy influence the institutional set-up of your unit and the way you collaborate with other entities?

Inwiefern beeinflussen die Ziele der Strategie die institutionelle Struktur (des Referats/Ministeriums) und die Art und Weise wie Sie mit anderen zusammenarbeiten?

2.4. Could you describe how you actually execute the policies in your ministry/unit/agency? What works and why? What doesn't and why?

Könnten Sie mir bitte beschreiben wie Sie/Ihr Referat die Strategie konkret umsetzt? Was funktioniert hier gut, was weniger?

Add on questions / weitere Fragen

- Could you describe the workflow between the people/departments involved in the implementation process? Könnten Sie mir den Arbeitsablauf zwischen den beteiligten Personen / Abteilungen erläutern?
- How do you avoid contradictory action/action pulling in different directions? Wie gewährleisten Sie, dass es nicht zu widersprüchlichen Maßnahmen innerhalb der Strategie kommt?
- How do you avoid neglecting some areas (technologies, research topics, actors)? Wie stellen Sie sicher, dass es nicht zur Vernachlässigung von Bereichen kommt (Technologiesparten, Forschungsthemen, Akteure)?
- What are important barriers to a successful implementation? How do you deal with those? Worin sehen Sie wichtige Hürden für eine erfolgreiche Politikimplementation und wie gehen Sie mit diesen um?
- Are there any noticeable incentives for better coordination? Gibt es spürbare Anreize für eine besser Absprache und Koordination unter den Beteiligten?

Focus 3: Capacities:

(strategic) capacities of the involved actors and aspects of leadership

The success and failure of public policies does not only depend on coherent formulation and implementation but also on the commitment and the **strategic capacities** of the actors involved. Thus, it is crucial to elaborate on the topics of leadership, management, and strategic skills when analysing the national innovation strategies.

Regarding this analysis, some scholars suggest a division between "**strategy thinking**" and "**strategy making**" of the actors involved, the latter referring to the actual task of setting up and implementing certain policy strategies (external strategy process), the former suggesting an analysis of the internal strategy process. The following questions focus on the internal strategy process and the management of this undertaking respectively.

Core interest: How is the *strategic capacity* of the actors involved and coherent management (leadership) organized/operationalized regarding the strategy?

Wie werden die strategischen Fähigkeiten der Beteiligten eingebracht und ein kohärentes Management der Hightech-Strategie gewährleistet?

Main questions:

3.1. Does the formulation and implementation of the national innovation strategy require specific "strategic" skills from the actors and what are they?

Erforderten die Formulierung und Umsetzung der Strategie Ihrer Meinung nach spezielle "strategische" Fähigkeiten der *beteiligen Akteure? Wenn ja, welche wären das?*

3.2. What unit/department is most influential in the implementation of the strategy? Why? Who else is a key figure/unit?

Wer hat Ihrer Meinung nach die operationale Leitung der Strategie inne und wie äußert sich das? Wer ist weiterhin wichtig (Person/Referat)?

3.3. Do you think your unit/ministry is adequately equipped for the implementation of the strategy in terms of workforce and qualification of employees? The time frame given? Information gathering and processing (*ex-ante expertise, ex post evaluation)*?

Haben Sie das Gefühl, dass Ihr Referat/Ministerium für die Umsetzung der Strategie angemessen ausgestattet ist u.a. mit Blick auf die Anzahl und Qualifikation der Mitarbeiter/-innen, dem Zeitrahmen für die Implementation sowie den Möglichkeiten Informationen einzuholen und zu verarbeiten (ex ante Expertise, ex post Evaluationen)?

3.4. In your opinion, what are the areas that have been most relevant in the management of the strategy? How would you characterize the relationship between politicians and civil servants in the implementation of the strategy?

Was sind für Sie die wichtigsten Aspekte des Managements der Hightech-Strategie?

Wie würden Sie die Beziehung/den Austausch zwischen Politikern und politischer Administration im Zuge der Umsetzung der Strategie charakterisieren?

Add on questions / weitere Fragen

- What are the easiest and the most difficult issues in the leadership and management when implementing the strategy? Was sind Ihrer Meinung nach die einfachsten und schwersten Aufgaben mit Blick auf das Management der Hightech-Strategie?
- What are your knowledge/data sources and who do you turn to when you need expertise regarding the strategy (components, technology fields, branches)? Is there an internal knowledge unit? Or do you request external expertise? Was sind Ihre wichtigsten Informationsquellen und woher beziehen Sie relevante Expertise (bzgl. Technologie, Branchen)? Gibt es eine interne Rechercheabteilung? Oder wird die Expertise extern angefordert?

- Which other countries or country strategies serve as a benchmark? What about the role of the EU regarding the national strategy? Welche anderen Länder und deren Strategien dienen Ihnen zur Orientierung? Wie beurteilen Sie die Rolle der EU im Bezug auf die Hightech-Strategie?
- What triggered the changes between the first national strategy and the revisions later on? To the extent that this necessitated changes in particular policies: How did you go about improving/changing them? Wie kam es zu Veränderungen zwischen der Hightech-Strategie von 2006 und der Hightech-Strategie 2020? Anhand welcher Kriterien haben Sie Veränderungen durchgeführt?
- Who and what do you think is most important for the long-term success of the strategy? Wer und was, denken Sie, ist am Wichtigsten für den langfristigen Erfolg der Hightech-Strategie?

Concluding questions:

What changes, if any, do you think the introduction of the notion of "strategy" brought about in innovation policy making?

Glauben Sie, dass sich durch "die Rede von Strategie" Veränderungen im Bezug auf die Innovationspolitik ergeben haben?

What do you see as the most urgent challenge in innovation policy?

Wo sehen Sie den größten Handlungsbedarf in der deutschen Innovationspolitik?

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