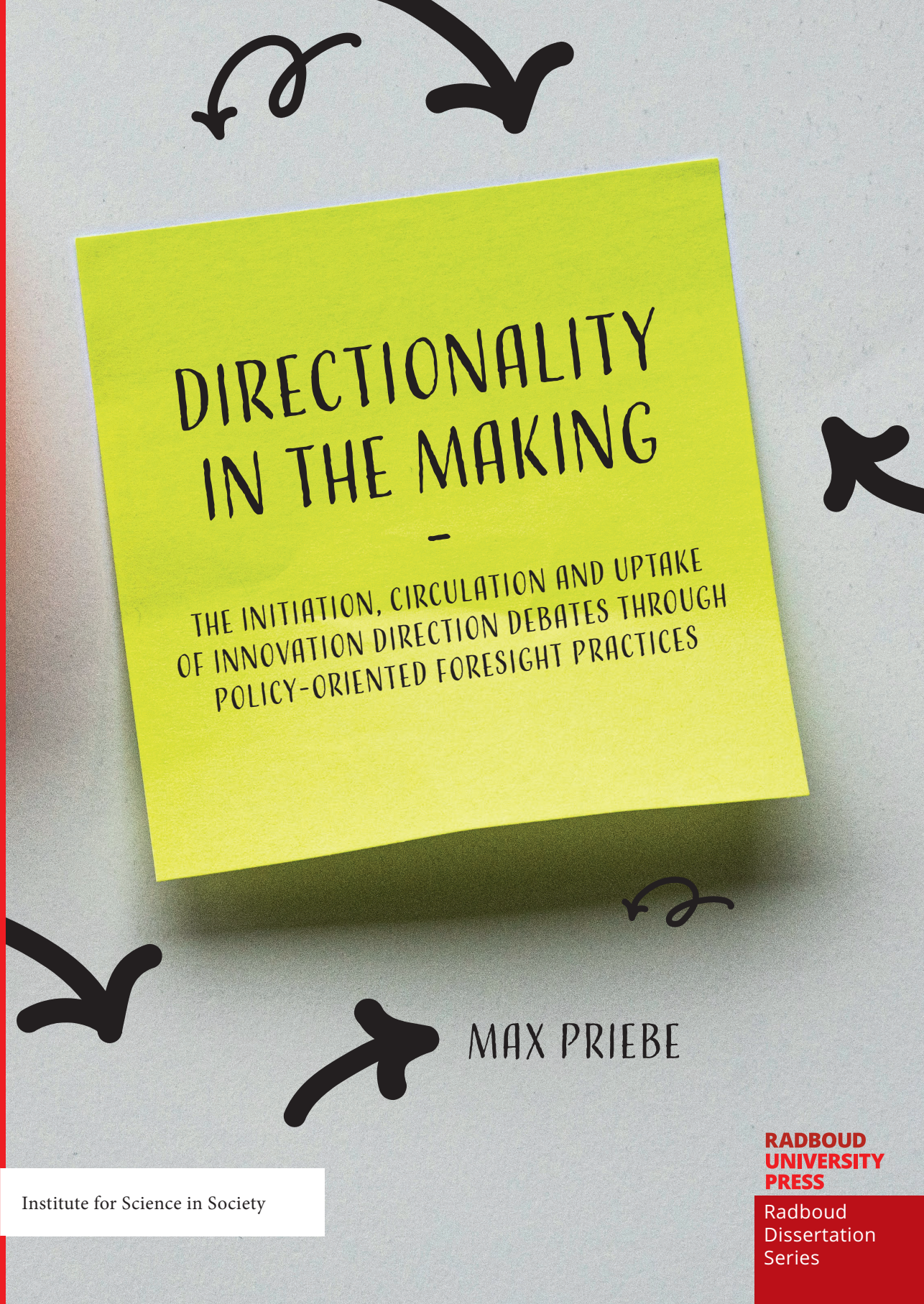

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Directionality in the Making

-

The initiation, circulation and uptake of innovation direction debates through policy-oriented foresight practices

Max Priebe

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The initiation, circulation and uptake of innovation direction debates through policy-oriented foresight practices

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Directionality in the Making

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by

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1. Introduction

"This [...] is the essence of politics: the ability to reflect consciously on different directions one's society could take, and to make explicit arguments why it should take one path rather than another."

(Graeber and Wengrow, 2021, p. 86, referring to Boehm, 1999)

Socio-technical change can take different forms, directions and velocities. In the quote above, the anthropologist-archaeologist duo David Graeber and David Wengrow remind us that human history is replete with politics of assessing, reflecting and shaping the pathways under which processes of change unfold. In their book, "The Dawn of Everything" (Graeber and Wengrow, 2021), they argue that the notion of the Neolithic Revolution—the assumption of a rapid transition from Paleolithic hunter-gatherer life to the introduction of agriculture, the domestication of animals, and the emergence of the first settlements—is an inaccurate narrative. Drawing on archaeological evidence, they emphasize that this process was far from a rapid and linear transition, as it took around 3,000 years before agriculture was fully adopted (ibid. p. 233). They suggest that this was not an accidental late adoption but an intentional pause, during which Neolithic societies were engaged in carefully experimenting with various innovations and proto-urbanism, while reflecting on social causes and consequences for social orders.

Why begin a dissertation on 21st century innovation governance with an anthropological discussion about the evolution of early human societies? I suggest that this debate is strikingly relevant to research on the contingency, direction and velocity of socio-technical change in the 21st century. In a time, when our societies possess the technological means to move towards sustainable futures—transition away from carbon intensive energy systems, revolutionize soil degrading agriculture and transform linear extractivism of industrial production—we observe an ambivalent combination of commitment, hesitancy, delay and backlash for changing socio-technical pathways. Experiments and transitions in all sorts of socio-technical regimes show us the challenging, conflictual and continuous process of finding a clear, universally supported direction for change.

Nonetheless, society does not stand still. On the contrary, social theory emphasizes that our contemporary societies evolve through constant change. The modern concept of progress unfolds through an acceleration of practices that persistently (re-) produce and dynamically (de-)stabilize social orders (Rosa, 2015). While discourses in the social sciences have oscillated between discarding, defending or reinventing the contested notions of modernity and progress (e.g. Latour, 1993; Eisenstadt, 2002; Jasanoff and Kim, 2015; Reckwitz, 2024), innovation has emerged as a dominant analytical framework, a category for ordering expectations of change and a recipe for accelerating socio-technical change (Godin, 2017; Pfotenhauer et al., 2019).

As innovation becomes increasingly reflexive, heterogeneously distributed, and ubiquitous (Rammert, 2002), all sorts of issues—economic, social, political,

ecological, military, public health and others—are now framed as problems of innovation (Pfotenhauer et al., 2019). In turn, innovation theories guide much of the thinking about how to overcome inertia and lock-ins, how to accelerate change, how to disrupt path dependencies and how to create new pathways (Garud et al., 2010; Sovacool et al., 2020; Fuchs and Ziegler, 2024).

The proliferation of this innovation imperative has given rise to research concerning the conditions, evolution and direction of innovation. Complementing discussions concerning the alignment or non-alignment of political, economic and social interests, research has emphasized the role of geographies of innovation, science and politics of innovation, innovation's social appraisal and cultures of innovation (Irwin, 2006; Voß and Amelung, 2016; Coenen and Morgan, 2019; e.g. Binz et al., 2020; Irwin, 2023; Pfotenhauer et al., 2023; Stirling, 2024; Uyarra et al., 2025). This research has amounted to a rich and influential body of knowledge. Being both an object and a result of this research, state policies for promoting innovation have gained traction.

After various "dance moves" in the development of science, technology and innovation (STI) policy's theory and practice (Kuhlmann et al., 2010), the co-production of policy and scholarship has led to innovation policy spanning boundaries between different policy domains. With innovation policies now addressing sustainability transformation and so-called 'grand challenges' the scope of action and legitimacy of such policies has been shifted and reframed in comparison to preceding policies that focused on economic growth or international competitiveness and were treated separately to questions of sustainability or science and technology policies (Flink and Kaldewey, 2018; Schot and Steinmueller, 2018). The extended scope of innovation policy has put emphasis on questions concerning strategic prioritization, assessment and anticipation of pathways.

This gives rise to the phenomenon under investigation—the phenomenon of directionality, which is connected to general features in modern society and specific trends in innovation policy. As previously asserted by the sociologist Norbert Elias, decades before the discourse on risk, uncertainty and poly-crisis gained momentum, every planned development is intertwined with broader unplanned developments (Elias, 2009). Notions of knowledge, control and planning are, in modern societies, complicated or subverted against the background of unplanned developments (van Woerkum et al., 2011). Given the unpredictability of socio-technical change Collingridge's dilemma (Collingridge, 1980) reminds us that the ability to direct specific developments decreases the more socio-technical change is adopted and the more its shape and effects are

understood. As a result of this epistemic dizziness, many policy concepts and instruments aim to remain flexible and open to the uncertainties of change.

Despite these increasing complexities, policymakers and innovation experts practice new forms of directing innovation. Missions, scenarios and roadmaps are among the many deliberative polito-epistemical practices and devices that governments and public administrations experiment with and employ to explore or orchestrate socio-technical change. Thereby they purposefully seek to provide orientation for future pathways of change while recently facing substantial geopolitical turmoil, be it the energy crisis in the wake of the Russian attack on Ukraine, the race for technological dominance in Artificial Intelligence between the US and China or uncertainties around the promotion of sustainable technologies after Trumps' reelection. The discourse of directionality is not only an academic debate but materializes in concrete policy practices that respond to political uncertainties in manifold ways.

Behind the idea of purposefully directing innovation loom diverse scattered and arena-spanning deliberative processes. This *directionality in the making* occupies a spectrum of activities ranging from public engagement to technology assessment, to policy-oriented foresight. While they are organized in different communities and differ in their scope, they share a common aim. Through research, deliberation and reflexivity they aim to allow innovation policy to be at the same time flexible and able to promote directions. Therefore, they aim to collectively and continuously anticipate future pathways (Stirling, 2008; Guston, 2014; Stirling, 2024).

This is not an easy exercise, as the formulation of goals pursued through innovation is a political process unfolding from different normative positions (Ziegler, 2020) with actors asserting power, leveraging privilege and expertise or building legitimacy (Stirling, 2008, 2024). Ideally, these practices should allow heterogenous actors the exploration of alternative directions, pathways and velocities for socio-technical change while embracing the "irreducible pluralities of possibility" that exist beyond Western capitalisms' hegemonic framings of innovation (Fuchs and Ziegler, 2024; Stirling, 2024).

The practices under scrutiny in this dissertation, which articulate the phenomenon of directionality, are under steady pressure between these deliberative ideals and intersecting interests. They aim to bring about the articulation, deliberation and setting of directions in the context of innovation policy. Specifically, my research has focused on foresight, public engagement and their interactions with policy. The

objective of this thesis is to examine these practices through empirical case studies in order to produce insights into the overarching phenomenon of directionality.

Before zooming in on the overall research approach and research question of the thesis, I outline how the interaction of different discursive streams, innovation research and practice, have constituted directionality, firstly, as an academic discourse at the edges between STS, innovation and transition studies and, secondly, as a problem for policy that has been responded to with state-driven practices for the initiation, circulation and policy uptake of directionality debates.

The science and politics of directing innovation

In order to understand how the state promotes and shapes discussions and decisions concerning innovation directions, we first need to understand how science has constituted technological trajectories, pathways of innovation and their directions as perceivable and shapeable objects of research and governance. Without developing an extensive genealogical argumentation here, I want to briefly introduce fields of research that have shaped the discourses, knowledge base and practices relevant for promoting and directing innovation through policy.

The conceptualization of innovation directions has historically emerged against the backdrop of debates in economics (Schot and Steinmueller, 2018; Andersson and Hellsmark, 2024). While dominant neoclassical economic thinking emphasizes the role of market forces in shaping technological development, the Schumpeterian notion of innovation underscores the role of entrepreneurs in catalyzing techno-economic change. However, beginning in the 1980s, evolutionary economists have challenged this conventional understanding. Their research on the role of technological change for economies led them to critique the market-deterministic view and emphasize the importance of technologies for the economy and socio-technical change (e.g. Dosi, 1982; Dosi et al., 1990). Following this emphasis, new questions arose and connections to other fields of research and practice were made. As such, geographers, economists and policymakers joined to discuss spatial dependencies and systemic factors influencing socio-technical change within regional and national systems of innovation (e.g. Edquist, 2013). The focus on technologies furthermore promoted boundary spanning between economic research and studies of science and technology.

These fields of research, dominated by social scientists, approached the topic of innovation by another route than economics. Their research developed against the backdrop of Marxist historical determinism, technological deterministic thought, and technoscientific truth claim. In this regard, social science interested in technology came to emphasize the contingency and politics of socio-technical change (Winner, 1980; e.g. Bijker and Law, 1992). This line of research, which proved formative for the field of STS, argued that scientific discoveries and technology trajectories can take many directions (Bijker and Law, 1992; Bijker et al., 2012; Latour, 2015). Since the 2000s, STS scholars have directed their attention to inquiries concerning innovation leading to a convergence of interests between STS and economic research (Irwin, 2023). In the light of the inherent openness of socio-technical change and its co-productive interplay with social order (Jasanoff, 2004), a sub-field in STS took shape around questions of power, responsibility and deliberate social choice in the governance of innovation (Stirling, 2008; e.g. Owen et al., 2012). Through their critiques of and engagement with innovation policy, sociologists, philosophers and scholars from STS have (re)discovered it as an object of research (Irwin, 2023) and recently joined the discussions regarding innovation directions and the role of state in promoting and steering them.

These reciprocal interactions between economists, geographers, sociologists and policy analysts, give rise to an interdisciplinary field of study examining innovation policy as an object of research while simultaneously shaping the emergence of policy concepts and instruments (Edler and Walz, 2024). This brief overview, which will be elaborated further in Chapter 2, makes clear that the notion of direction in the context of innovation is somewhat ambiguous. On the one hand evolutionary economists and geographers conceptualize innovation direction in relation to systemic, spatial and material arrangements. On the other hand, it is used by sociologists as a metaphor for the closing down of contingencies during the social, cultural and political shaping of technology.

Two policy concepts are of specific relevance for this interdisciplinary field discussing the science and politics of directing innovation. Firstly, the concept of transformative innovation policy (Haddad et al., 2022; Haddad and Bergek, 2023) aims to provide a justification for directing innovation activities in market economies in a way that is believed to be beneficial for goal oriented transformative change. It describes the emergence, reconfiguration and decline of sociotechnical systems from niches to regimes (Schot and Kanger, 2018). Secondly, mission-oriented innovation policy has emerged as a concept for policies that aim to formulate clear and verifiable objectives, which are to be reached in a limited timeframe and foster new forms of collaboration

and coordination between heterogeneous innovation actors (Mazzucato, 2018a; Mazzucato, 2018b; Wanzenböck et al., 2020; Janssen et al., 2021). Herein, it is discussed under what circumstances the state should operate as an entrepreneurial actor (Mazzucato, 2018b) or orchestrator (Borrás and Edler, 2020) for strategically promoting certain directions of socio-technical change, and when it should refrain from doing so.

Both policy approaches have been crucial for the introduction of directional policies in various national innovation strategies such as in China, Japan, The Netherlands, Sweden, and Germany as well as the European Commission's Framework Programme for Research and Technological Development (FP). FP 8, the so-called Horizon2020 Programme, adopted the idea of societal challenges and transformative missions from mid-2010 onwards, thereby making available 77 billion Euros including 1 billion for the Green Deal alone. With FP 9 (Horizon Europe) and its five missions, directionality was further refined, with the European Commission emphasizing that its innovation policy "tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth."[1]

Analyzing directional policies in action, researchers found that many of the directions set in policy documents of the European Commission or European national governments were in fact the continuation of existing pathways (Coenen and Morgan, 2019; Wittmann et al., 2021). Transformative innovation policy and innovation missions in some cases turned out to be "old wine in new bottles" (Fagerberg, 2018) with their promises at times too hopeful. Analysts have noted that "… despite all the potential of science to contribute to equitable and sustainable social, economic and environmental futures, there is a gap between the claims of science and its delivery" (Ciarli et al., 2022, p. 7).

At the same time, politicians, influential think tanks and policy advisers have positioned themselves for or against specific missions or even the overarching idea of directional policy. At the time of writing, in the advent of the next European Framework Programme (FP10), publicly staged disputes that pit issues such as transformation, economic growth, competitiveness or security against each other are indicative of how unsettled innovation policy directions are.[2]

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1. https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/horizon-europe_en, last access: 01.03. 2025.
2. For example: https://sciencebusiness.net/viewpoint/planning-fp10/viewpoint-next-framework-eu-needs-get-back-economic-basics and https://sciencebusiness.net/viewpoint/planning-fp10/viewpoint-framework-programme-10-needs-balance-basic-and-applied-research, last access: 01.03. 2025.

While these criticisms show that innovation policy is an intrinsically contentious and conflictual field, these contestations also prove that directing innovation through policy is a relevant concern. As it touches upon questions concerning the role of the state it produces friction.

Directionality, the role of the state and its citizens

The role of the state in setting directions of change is contested. On the one hand, liberal political discourse has established the notion of technology-neutrality that defies state interventions in the ostensibly free evolution of innovation (Azar and Sandén, 2011). On the other hand, economists, innovation and transition scholars, such as Mariana Mazzucato, have advanced a scientific discourse that demonstrates how the state already shapes innovation activities and, on the other, encourages actively tilting (rather than leveling) the playing field for innovation (Mazzucato and Perez, 2015; Mazzucato, 2016).

Scholars of innovation policy have researched the implications for such a transformative and entrepreneurial role of the state (Borrás and Edler, 2020). They justify these roles against critics of market interventions, the concept of "directionality failure" has been developed (Weber and Rohracher, 2012; Lindner et al., 2016). As a recourse on so-called market failures, it is based on the supposition that markets are "blind" (Dosi, 1982), which can ultimately lead innovation actors to pursuing directions with "suboptimal outcomes" for society as a whole (Lindner et al., 2016). According to this research, directionality failures occur if a lack of collective coordination and reflexive arrangements prevent goal-oriented transformative change.

This deficit construction of directionality contributes to innovation policy's "appetite" for reflexivity (Pfotenhauer, 2023). In order to fulfill and legitimize the role of a transformative state, innovation policy engages with different stakeholders and publics (Borrás and Edler, 2020). For directing innovation, the state needs to create new relationships with its citizens, scientists and entrepreneurs. Hence, directionality becomes delimited. More than a theoretical consideration in a scientific discourse or concept in policy debates regarding technological trajectories and innovation directions, directionality appears as a deliberative practice for exploring socio-technical change. Thus, directionality becomes a social practice for appraising the multiplicity of possibilities for future pathways and directions of socio-technical change with citizens (Stirling, 2024).

In the early 2000-s, Andrew Barry conceptualized 'technological citizenship' as a crucial pillar of "governing a technological society", the subtitle of his book "political machines". With this, he means two things: "…interactive and networked technologies have come to be seen as a key resource in the making up of citizens", and secondly, he adds that "…the individual citizen is increasingly expected, and increasingly expects, to make his or her own judgments about scientific and technological matters" (pp. 127-128). This perspective has until now not ceased to offer valuable insights into how "technological societies" are governed in Europe.

Today, technological citizenship goes beyond the making of citizens and the communication of their normative judgement. It also entails the expectation to actively cooperate in finding 'challenges' to be tackled, assessing innovation directions and ultimately collaborating with science, technology and innovation. Concepts such as open innovation, social innovation, responsible research and innovation, anticipatory innovation governance, prosumerism and many others are illustrative of how the innovation imperative has expanded. Existing innovation systems are opened-up for new actors (Stirling, 2008; Voß and Amelung, 2016). In an effort to become more effective, they are reconfigured by "social fixes" (Frahm et al., 2021). That is, many protagonists of the practice field of directionality turn to public engagement and involvement of stakeholders affected by innovation policy to avoid directionality failures.

Hence, citizens are no longer mere passive users of science, technology and innovation, but rather are promoted to become active co-shapers of innovation directions. What is seen as a promising direction to follow, however, is not easy to discern.

The problem of directionality and prevalent practices

The creation of practices and spaces for discussing and articulating directionality between the state and its citizens is challenging. It is questionable whether society is genuinely concerned with innovation policy. Some directionality debates may get public attention, as for instance discussions concerning the regulation and promotion of AI technologies. Indeed, specific technologies and innovations are subjected to contestation and politicization (Hausstein and Lösch, 2020). However, innovation policy remains a sidelined topic in election campaigns, party programs and political movements. It is argued that the "temporal buffer" between developing innovation policy, testing technologies and concrete effects on the everyday lifeworld's of people restricts possible contestations from societal actors (Haugland,

2023). Discursive figures such as technology-neutrality further undermine the emergence of such discourses and thus depoliticize directionality by suggesting that there are no strategic decisions to be made.

This politicization and de-politicization of innovation policy constitutes the problem of directionality. Who can organize deliberation concerning innovation directions (given the multiplicity of actors involved in research, technology development, innovation, practice and regulation)? How and where can deliberation be achieved (given the hypothetical to speculative character of imagining future innovation directions)? Norbert Elias has suggested that such deliberations will become increasingly more difficult:

> "Paradoxically enough, the steady increase in the capacity of men, both for a more detached approach to natural forces and for controlling them, and the gradual acceleration of this process, have helped to increase the difficulties which men have in extending their control over processes of social change and over their own feelings in thinking about them." (Elias 2007, p. 231)

Not only does thinking about socio-technical change processes become more difficult, it is also unclear where this happens. Directionality discussions, and sometimes even negotiations, take place at different sites such as in literature and media, most strikingly in the form of science-fiction, in finance, for instance, when start-ups go through funding rounds. Whether intended or not, by circulating collectively-held future expectations and socio-technical imaginaries, these discussions shape people's attention and attitudes towards innovation directions (Borup et al., 2006; Alvial-Palavicino, 2015; Jasanoff and Kim, 2015).

In order to attract the attention of scientists, entrepreneurs and citizens amidst plentiful imaginaries, the toolbox of innovation policy has been elaborated (Voß and Amelung, 2016). Accordingly, articulations of socio-technical futures are developed in strategic documents. Through "techniques of futuring" or real-world testing they become institutionally stabilized and are publicly performed (Engels et al., 2019; Oomen et al., 2021). Thus, the state cultivates specific practices and places to discuss innovation directions.

Participatory foresight, deliberative technology assessment, or science communication are funded by the state, public administrations or dedicated public sector organizations to foster discussions concerning long-term innovation

directions. Researching these practices can be challenging. The concrete sites where these practices play out are often scattered and not always easy to discern for researchers. My interest is not to provide a definition of these sets of practices or to help differentiate them from each other. Instead, I aim to understand them regardless of existing labels. Technology assessment and foresight, for instance, are arguably two different fields of practice and research as they organize themselves in distinct epistemic communities and are grounded in different histories. However, they overlap in that they bring about the social appraisal, exploration and performativity of innovation directions.

This phenomenon lies at the very core of this dissertation: state-driven, future-oriented practices to deliberate socio-technical change processes, directions, pathways and velocities as a multiplicity of social choices. Therefore, this thesis scrutinizes how different sets of practices, covering a spectrum from foresight through policy to public engagement, overlap to shape directionality in the making. The focus of my empirical research has been on foresight. My own involvement, enthusiasm, quarreling and doubting with state-driven foresight practices has provided the backdrop for this research. Understood as an expression of the encompassing directionality discourse, foresight comes down to three aspects.

Firstly, foresight represents how the state's institutions, and the civil servants that sustain them, have recently embraced responsive, participatory and reflexive approaches to policymaking. Through shifts from mode1 to mode2 knowledge production, from the triple helix model of innovation to the quadruple helix and beyond, from government to governance, manifold consultative formats have emerged as tools for organizing socio-technical change (Voß and Amelung, 2016). This experimental democracy builds on deliberative and participatory practices at the intersection between innovation, policy and society and might be understood as the generative context of directionality discourse.

Secondly, foresight stands for a shift in planning and governing. The problematization of the future as an unknowable temporal category as well as the experience of multi-crisis have resulted in undermining once-dominant unidirectional planning practices (Wenzel et al., 2020). Today, researchers agree that socio-technical change cannot be predicted. Instead of predictions, forward-looking practices develop multiplicities of futures and explore alternative sets of scenarios, to account for the complexity of interactions and the uncertainty of developments. This pluralization of futures has been endorsed by an increasing number of organizations and public administrations. In this vein, the policy-oriented practice of foresight has been developed and embedded over

the past five decades in national governments and international organizations. In the vocabulary of foresight, it supports the exploration and analysis of future directions, thereby aiming to produce strategic intelligence (Robinson et al., 2021). The terms that have been developed in this context, think of "horizon scanning", "orientation", "foresight" or "direction", are directly linked to the larger nautical metaphor of governing (based on the Greek kybernan, to steer, to pilot). However, being more than illustrative metaphors, these terms are used to frame policy-oriented practices.

Thirdly, foresight presents a case for studying how futures, such as future expectations (Borup et al., 2006; Alvial-Palavicino, 2015), socio-technical imaginaries (Jasanoff and Kim, 2015), visions (Ferrari and Lösch, 2017), become socially performative (Oomen et al., 2021) as governing tools. The produced "futures play an important role in the political games of nudging the directionality of sociotechnical development by means of exercising modal power" (Urueña, 2022). Research has emphasized that shared future expectations allow groups of actors to influence technological and political dynamics towards specific future directions (Kemp et al., 2007; Haugland, 2023). While foresight practices such as scenario planning have developed out of contexts in foreign and defense policy, it has become a standard element in the strategy toolboxes of the private and public sector alike.

Overall approach and research question

This thesis starts from the observation that our contemporary societies relentlessly cultivate future-oriented, discursive practices and spaces to trigger thinking about how innovation might contribute a deliberate path to social progress or why it fails to do so. Deliberation concerning innovation directions takes place in various institutional contexts. While also universities, research organizations, large cooperations, start-ups and charitable organizations engage different publics in discussing innovation directions and missions, this dissertation concentrates on the initiatives of public administrations in governments. This focus allows to scrutinize the interplay between deliberative practices, the shaping of discursive spaces such as arenas and the directionality of innovation policy.

My interest lies in the practices creating discursive spaces through which state actors, such as civil servants in the public administration, attempt to gather diverse perspectives, expectations and interests that shape how innovation policy addresses the contingency of directions of socio-technical change. The specific subject of research encompasses state-sponsored foresight practices, the participants

involved, the discursive and deliberative spaces in which these practices occur, and the interactions they trigger between policy, fields of knowledge production and democratic interest-formation. Thereby, I ask how directionality is practiced through policy-oriented foresight?

In order to empirically explore this overarching question, a variety of foresight processes and research projects conducted between 2020 and 2024 have been used to gain access to the fields in which foresight practices engage with innovation policy. My way of approaching these fields methodologically is through embedded, qualitative social science research as an engaged researcher (Chapter 3). Three specific contexts are decisive for this: The reflections I facilitated concerning a large foresight framework for the European Commission (Chapter 4), my involvement in a deliberative experiment in German innovation policymaking (Chapter 5), my role as an associate researcher in the assessment of foresight institutionalization in the German Federal Government (Chapter 6). I argue that zooming-in on these contexts provides insightful cases for understanding the co-production and appraisal of innovation pathways as a neither fully formalized, nor completely hazardous, ever-evolving, arena-spanning process—that is directionality in the making.

Structure of the thesis

This work contributes to our understanding of the meaning and practices of foresight in the context of innovation governance, strategy and planning, and links them to the question of directionality in innovation discourses. Drawing on practice-theoretical perspectives adapted to the context of innovation policymaking, I explore the ways how policymakers, scientists and consultants envision, articulate and negotiate future directions, before stabilizing them through foresight-policy interactions in strategic state documents.

The thesis builds on concepts from and interaction between science and technology studies (STS) with innovation studies, transition studies and organization studies. While the directionality discourse has mostly been developed against the backdrop of evolutionary economy and political science, I adapt and further refine a sociological perspective for studying directionality inspired by research in STS, sociology of knowledge and practice theories (Chapter 2 and 3). In particular, I draw on practice theories (Shove et al., 2012; Spaargaren et al., 2016), anticipatory practice research (Alvial-Palavicino, 2015; Aykut et al., 2019; Oomen et al., 2021), socio-technical imaginaries (Jasanoff and Kim, 2015; Pfotenhauer and Jasanoff, 2017) and

institutional theory (Scott, 2008) to understand practices that bring about innovation direction debates and connect those with questions of directionality in policy frameworks (Wanzenböck et al., 2020; Janssen et al., 2021; Haddad et al., 2022). My findings underscore that foresight practices exercise a key role for directionality in the making. Foresight practices are not only symptomatic for the increasing specialization and rationalization of future-making practices in contemporary societies but also for the imagination, exploration and appraisal of innovation pathways and the direction they take.

The dissertation project resulted in multiple different academic outputs, whereas three original pieces of research form the core of this dissertation (the bold cells in table 1). They all complement the overall research question concerning practices for directionality that has been the common thread of my dissertation research over four years: How does foresight initiate (Chapter 4), circulate (Chapter 5) and facilitate uptake (Chapter 6) of innovation direction debates? This dissertation discusses these aspects and synthesizes findings to grasp an understanding of the production of legitimacy and reflexivity in innovation policy arrangements (Chapter 7). Before presenting the case studies, the thesis commences with a literature review-based conceptual framing of the directionality discourse (Chapter 2), the findings of which form the basis of the research design (Chapter 3).

Table 1 Specific research questions addressed in the PhD research

Specific research question	**Chapter / published article**
How did the discourse on directionality historically develop and what are key notions and concepts to consider for its conceptual framing?	Chapter 2 To be submitted: Literature Review and Conceptual Framing of the Directionality Discourse
How does foresight initiate discussions regarding the directionality of innovation policy?	Chapter 4 Published: Priebe, Max; Warnke, Philine; Weber, K. Matthias (2025): Setting the scene for discussing innovation policy directions: Foresight as a practice of synchronizing. In: Futures 173, 103681. DOI: 10.1016/j.futures.2025.103681.
How are innovation direction debates circulated through different arenas? What practices are involved in moving missions through arenas, how do actors therein respond and how does this process contribute to the shaping of directionality?	Chapter 5 Published: Priebe, Max; Herberg, Jeremias (2024): Regioning mission-oriented innovation policy: The articulation of directionality between federal and regional arenas in the German High-Tech Strategy. In: Environmental Innovation and Societal Transitions 52, 100899. DOI: 10.1016/j.eist.2024.100899.
How do the institutional conditions, working practices and routines of public administrations in government shape foresight-policy interactions? How can this interaction influence the setting of policy directions?	Chapter 6 Published: Priebe, Max; Veit, Sylvia; Warnke, Philine (2024): Understanding Foresight-Policy Interactions: The Role of Institutionalization. In: Futures & Foresight Science, e197. DOI: 10.1002/ffo2.197.
What is the role of dynamic capabilities for transformative policymaking in the case of industrial and mission-oriented policies in Germany?	Part of Chapter 7 In review: Wittmann, Florian; Berghäuser, Hendrik; Eckstein, Johannes; Hummler, Andreas; Lindner, Ralf; Priebe, Max; Rogge, Karoline S.: Everyone on board? Dynamic capabilities and their role for transformative change in Germany? In: Politics & Society.

2. Directionality in the making: Conceptual framing

The aim of the following literature review is to provide an overview and conceptual framing of the directionality discourse that has emerged at the nexus of studies of science, technology, innovation and transitions. The literature review focusses on these three interdisciplinary academic fields, which empirically study but also advice and critique innovation policy. This focus also helps to narrow the search field. In turn, many interesting discussions in other disciplines and fields of research, such as in the philosophy and history of technology or other sectoral fields, such as research on directionality in agriculture, are excluded from this literature review.

The results of the literature review are presented in the form of a brief genealogy, a differentiation of different notions within the directionality discourse, and a summary of key concepts. The discussion of these elements offers a nuanced understanding of the directionality discourse and its nested notions, which form the conceptual framing for this dissertation. The findings of this literature review are employed to further refine and operationalize the research questions of the dissertation presented above, thereby informing the research design described in Chapter 3.

Literature review

A first systematic review was conducted in December 2022 to gain an oversight of the discussion. The approach was inspired by existing review designs, which followed similar research interests (Sovacool et al., 2020; Haddad et al., 2022). In the first search, candidate publications were identified through a search in Elsevier's Scopus database. The search terms used to scan articles' titles, abstracts and keywords within the database reflected the focus of this dissertation regarding notions of directionality in innovation policy, socio-technical change and mission-oriented policy and was further limited to articles from social science journals.[3]

The result of this first search was a list of 114 articles, all published until 2022. In the first selection stage, all articles were screened, focusing on the articles' abstracts in the first instance. While questions about the directionality of innovation were inherent in almost all of these publications, not all of them focused on directionality as an aspect of innovation governance or innovation policy. For instance, topics included sustainability transitions and regional development. After qualitatively assessing their relevance for the dissertation project by selecting only those articles concerned with socio-technical change and innovation policy, 31 articles were listed for review.

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3. The exact search query was: TITLE-ABS-KEY ("Directionality") AND TITLE-ABS-KEY (("innovat* polic*") OR ("innovation") OR ("socio-technical change*") OR ("mission-oriented")) AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "ENVI"))

In the second stage, the selected publications were read, analyzed and classified into three groups, namely innovation studies, transition studies and STS. During the reading of these articles, additional publications were identified by reviewing each article's reference list. This "snowballing" was supplemented by targeted searches in journals and grey literature databases that were considered relevant but not indexed in Scopus, such as monographs and the STS journal "Engaging Science, Technology, and Society". In this way, a further 17 publications have been added to the list of publications available for review.

A second iteration of the literature review was conducted in December 2024 in order to reflect the recent growth and dynamism of scientific articles contributing to the directionality discourse. This second search excluded all articles resulting from the first list, that is all articles published before 2023. Apart from this alteration, the second search used identical search terms on Scopus. This time, a total of 73 were listed as candidate publications. Subsequently, 13 publications were selected based on the above-mentioned criteria and reviewed. The snowballing procedure described above resulted in additional 5 publications added to the review.

Both search iterations were followed by two review stages (see figure 1). In a conclusive, third stage, the selected publications were merged and resulted in a list of 66 publications for the review (see figure 2 for an overview of sources and annex for full list). The selected literature was analyzed by following the sociology of knowledge approach to discourse (Keller, 2011). This approach has been developed to scrutinize the interplay between the social production of knowledge in discourse and politics of knowledge. Concretely, this meant reconstructing the genealogy of different notions of directionality, the shaping of politics of knowledge in the domain of innovation policy and the hybridization of the term as the interaction of different fields of research in an emerging discursive arena. Thus, I adopt a sociological perspective for reading and analyzing the selected literature.

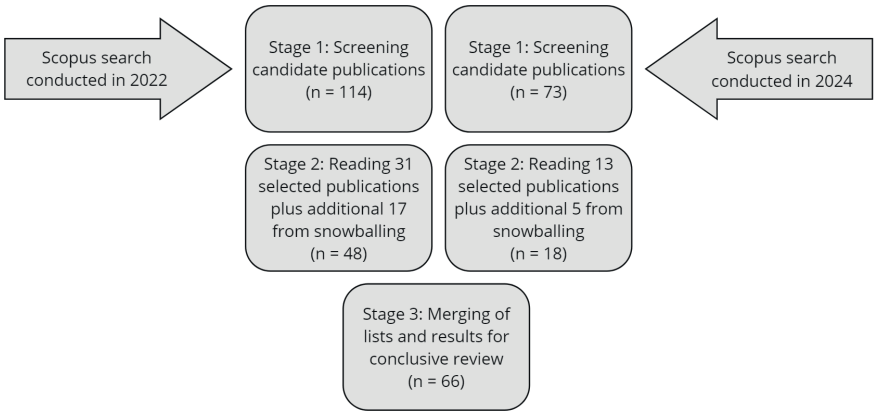

Figure 1 The search, selection and review process

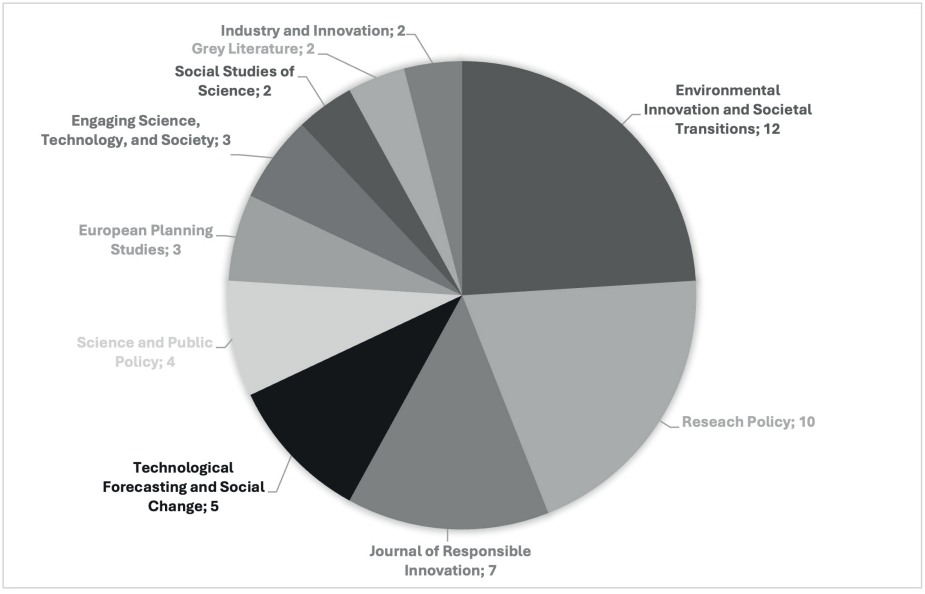

Figure 2 Overview of sources of reviewed publications (excluding sources with less than two publications)

Results: Directionality, an ambiguous notion

A brief history of the directionality discourse

The history of the directionality discourse in studies of innovation, transition, science and technology saw the development, bifurcation and interaction of different streams of research. With the great majority of the selected literature written in the 2010s and 2020s, the review focusses on the contemporary debate and present understanding of its evolution. However, as many of the listed publications provide a historical account of the emergence of the directionality discourse (Elzen et al., 2011; Røpke, 2012; Flink and Kaldewey, 2018; Mazzucato, 2018a; Schot and Steinmueller, 2018; Kanger and Schot, 2019; Stilgoe, 2019; Pfotenhauer et al., 2022; Irwin, 2023; e.g. Andersson and Hellsmark, 2024), it is possible to combine and compare them to present a collage of various disparate accounts regarding the historical emergence of the directionality discourse. The reviewed publications commonly reference key historical periods: the immediate post-war era, the planning phase of the 1970s, the rise of innovation systems frameworks starting in the 1990s, and the 2010s, which were marked by the establishment of ambitious sustainability goals.

Technological progress and innovation as an issue for political debate and deliberation

The earliest historical reference point in the publications reviewed is the post-World War II period. Schot's and Steinmüller's (2018) influential article "Three frames for innovation policy" unfolds its analysis against the backdrop of post-war Western innovation policy. During this period, economic theorists researching the economic contributions of science, technology and innovation supported a discourse that justified policy intervention in the case of 'market failures' and developed innovation policy under the framing of innovation for economic growth (ibid. ;Mazzucato, 2018a). While these developments established the foundation for later debates concerning directionality, science and research policy remained largely decoupled from technology policy or economic debates about innovation policy. Notable examples of where the policy domains and scientific discourse began to interact with each other include the mission-oriented research programs in the defense, energy and health sector in states such as the United States and France. Different technological choices contributed to discussions in policy and research about innovation directions, strategic priorities and policy practices best suited to explore and shape these directions.

These debates started to constitute an understanding of science and technology policy that sees the direction of technological progress as an issue for political debate and deliberation. Anderssen et al. (2024) describe how new aspirations took shape

in the context of an intellectual environment inspired by cybernetics and general systems theory. The discussions in scientific institutions, firms and state agencies amounted to the emergence of a distinct techno-optimist governmentality that promoted the science-based and goal-oriented management of technology and social change. In this regard, various authors point to the institutionalization of technology assessment, the proliferation of technology foresight and other anticipatory practices that aimed at exploring competitive advantages or societal risks thereby critiquing technological determinism and emphasizing contingency and strategic choices (e.g. 'picking the winners') (Schot and Steinmueller, 2018; Urueña, 2022; Haugland, 2023; e.g. Andersson and Hellsmark, 2024).

Systems of innovation, path dependencies and sustainability as novel points of reference for directionality

With the belief in control and planning of this time fading from the 1980s onwards, a shift arguably effected the emerging directionality discourse (Andersson and Hellsmark, 2024). This shift, as presented in the selected literature, emphasized structural conditions, enabling (or restricting) factors rather than choice. Primarily represented by evolutionary economists, debates turned from questions of normativity to questions of plausibility. The central claim of this discourse, that technological innovation is path-dependent, was supported by studies showing how it follows 'natural trajectories', can lead to 'lock-in' and shape 'technological regimes' (Andersson and Hellsmark, 2024 referring to the works of Nelson, Winter, Dosi and others), but also by research on the geographic 'stickiness' of techno-scientific knowledge that resulted in notions of national, regional and sectoral systems of innovation (Weber and Rohracher, 2012; Schot and Steinmueller, 2018; Uyarra et al., 2019; Flanagan et al., 2022; Andersson and Hellsmark, 2024). In this regard, the authors of the selected publications refer extensively to the works of Dosi, Nelson, Lundvall, Freeman and Edquist (e.g. Dosi, 1982; Dosi et al., 1990; Edquist, 2013).

It is important to note that this line of research did not critique understanding socio-technical change as a question of political and social choice. Rather, both discourses (Elzen et al., 2011) were decoupled. Unlike the social scientists critiquing technological determinism, these economists argued against the backdrop of neoclassical economy and the concept of market failure, proposing that the justification for state interventions in market economies should also account for system failures.

In the context of the international negotiation of sustainability goals in the 1980s and 1990s, the two variants of the directionality discourse meet in the field of sustainability transitions research (Andersson and Hellsmark, 2024). As a result of

the interaction of both discourse streams, normative choices and systemic conditions are discussed together. The majority of the literature in this review can be attributed to the emergence and proliferation of this field at the beginning of the 21st century, which conceptualized the 'multi-level perspective', 'transition management', 'deep transitions' (Elzen et al., 2011; Røpke, 2012; Schot and Kanger, 2018; Kanger and Schot, 2019; Pel et al., 2020; Pel et al., 2023), and the lack of clear directions of change in innovation governance as "transformation failure" (Weber and Rohracher, 2012; Lindner et al., 2016; Haddad et al., 2022). This development can also be understood as the production of new forms of legitimacy for innovation policy, at a time when the priorly hegemonial metaphor of a social contract between science and society declined and gave way for legitimizing science, technology and innovation as solutions for 'grand challenges' (Flink and Kaldewey, 2018; Pfotenhauer et al., 2019).

This new line of research did not stay confined in academia. The belief that technological leadership is a crucial factor for economic development and competitiveness extended towards 'grand challenges'. It led not only to the advancement and critical assessment of the growing directionality discourse, but further inspired the development of new policy approaches and practices, ranging from environmental planning, the governance of technological risk up to transformative innovation policy (Haddad et al., 2022; Haddad and Bergek, 2023).

Social appraisal and political missions

With the proliferation of these new practices, Stirling (2008) observes an "opening up" of policy towards stakeholders and the wider public in the governance of science and technology. In his much-noticed article in Science, Technology & Human Values, he connects reflexive, participatory, or responsible practice arrangements with STS literature (notably works by Jasanoff, Lash, Woolgar and Bijker), which analyzes the epistemic, cultural and political developments that constitute them. While the STS and innovation research communities have mainly worked in isolation from each other in the preceding decades (Irwin, 2023 citing Bhupatiraju et al. (2012) and Martin et al. 2012) a connection is remade through their shared interest in issues concerning the contingency of innovation, social choice, and the role of the state (e.g. Mazzucato, 2018a; Stilgoe, 2019). As STS perspectives, or at least STS vocabulary, enter the discussions on directionality, the question of social choice in the appraisal and commitment to specific innovation directions becomes more accentuated and skeptical. Critical reflections on the process of deliberating socio-technical change in society are brought to the fore by problematizing the newly established legitimacy (Flink and Kaldewey, 2018) or "social fixes" (Frahm et al., 2021), asking "who is driving innovation?" (Stilgoe, 2019) or "who is giving directions?" (Parks, 2022).

In parallel, scholarship in economics renegotiates the role of the state in industrial and technological development. Mazzucato (Mazzucato, 2016; Mazzucato, 2018a) argues that the focus on building horizontal linkages between actors has overlooked the importance of vertical policies and the role of public agencies in actively setting the direction of change. The proposition of mission-oriented innovation policy complements the transformative innovation policy debates in the field of transitions research, which are mainly focused on bottom-up niche activities, with the study of more top-down policies, i.e. missions as targeted, measurable and time-bound policy instruments, their governance, politics, environment and impacts (Grillitsch et al., 2019; Hekkert et al., 2020; Wanzenböck et al., 2020; Bugge et al., 2021; Bugge and Siddiq, 2021; Janssen et al., 2021; Haddad et al., 2022). In this light, the discourse on directionality becomes more attuned to strategic considerations, implementation deficits and concrete instruments in fields ranging from industrial policy over innovation to health. As decoupled discursive spaces begin to overlap, critiques of technological determinism, economic justifications for state interventions, and sustainability discourses merge into an increasingly cross-referential directionality discourse. A new interdisciplinary domain of study seems to develop.

With a growing body of research interested in the question of social appraisal of innovation directions and two dedicated special issues, critical studies on innovation and STS concepts are becoming "en vogue" (Pfotenhauer, 2023) creating a spin-off of the directionality discourse. Drawing from the formative work of Stirling (e.g. 2006, 2007, 2024), the most recent turn of the directionality discourse highlights the necessity to study directionality as a social and discursive practice that aims "grasping irreducible pluralities of possibility in balanced ways" and can be distinguished from "driving and accelerating processes of adoption and acceptance (the directing of innovation)" (Stirling, 2024) or "steering selected particular possible pathways rather than others (the direction of innovation)" (ibid.). This stream of research includes empirical research on the role of regional innovation cultures as contexts for shaping the social desirability and acceptability of innovation (Schmidt et al., 2018; Engels et al., 2019; Pfotenhauer et al., 2023; Priebe and Herberg, 2024) and theoretical reflections on justice, social innovation and exnovation in directionality (Fuchs and Ziegler, 2024; Maldonado-Mariscal and Hölsgens, 2024; Mintz-Woo, 2024; Papaioannou, 2024). Together, they bring to the fore counter-hegemonic frameworks of innovation and challenge dominant logics of techno-economic innovation.

Understanding the directionality discourse

The history of the directionality discourse in the previous section has shown that different streams of research have developed different understandings of what

directionality means. Before elaborating on selected key concepts that are discursively linked with the notion of directionality, I clarify these different meanings in an ideal typical way and summarize them in table 2.

One word, three notions

Directionality as a phenomenon in systems of innovation and transition processes: This notion departs from the assumption that innovation can follow different trajectories. It can be configured to serve different sociotechnical configurations, as depicted in figure 3. Directionality carries a dual understanding: Directions of socio-technical change may be analyzed under the aspect of desirability; or directions may be understood through the lens of plausibility in path dependent socio-technical change processes. Some authors refer to the first as "normative directionality" and to the second as "positive directionality". Research has been devoted to investigating the dynamics underlying the formation of directions, which are perceived as desirable through different forms of social evaluation (e.g. through governance, participation, self-reflection) on the one hand, and studying the socio-material characteristic of directions themselves, on the other. For most authors, normative directionality also signifies that innovation should not be pursued for the sake of innovation or economic growth only, but instead should be aimed at addressing important societal challenges from an interdisciplinary perspective.

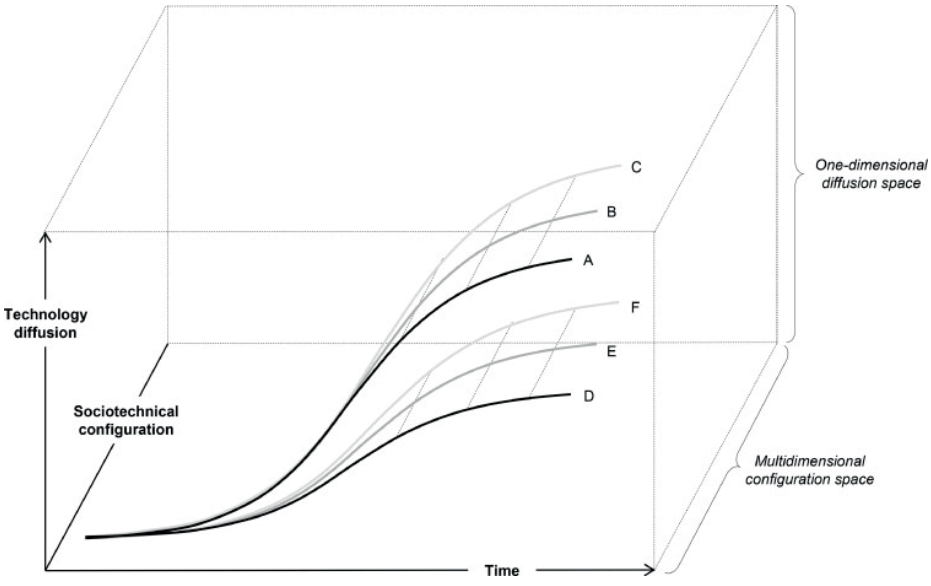

Figure 3 Different socio-technical pathways. Reprinted from Andersson et al. (2021) "The outcomes of directionality: Towards a morphology of sociotechnical systems" p. 114 (Creative Commons CC-BY license).

Directionality as a criterion for policymaking: This notion takes the idea of addressing societal challenges a step further and conceptualizes directionality for the context of policymaking. In this regard, innovation policy literature explores how policymaking can shape the direction of change by highlighting, on the one hand, how directionality can be implemented in policy mixes and, on the other, how policies can shape structural conditions (e.g. institutional, geographic or market conditions) that influence directionality, to ultimately steer innovation towards desirable outcomes. A key focus is on setting a clear direction for policy-driven change, while a lack of directionality is seen as a failure. Different approaches, such as mission-oriented and transformative innovation policy, advocate for specific state capacities, different degrees of top-down policy setting and bottom-up processes, whilst especially the literature concerning missions highlights the need for targeted, measurable, and time-bound missions to guide innovation effectively. In this understanding, directionality comes down to converging views and a clear setting of directions in the design, implementation and assessment of policies as depicted in figure 4.

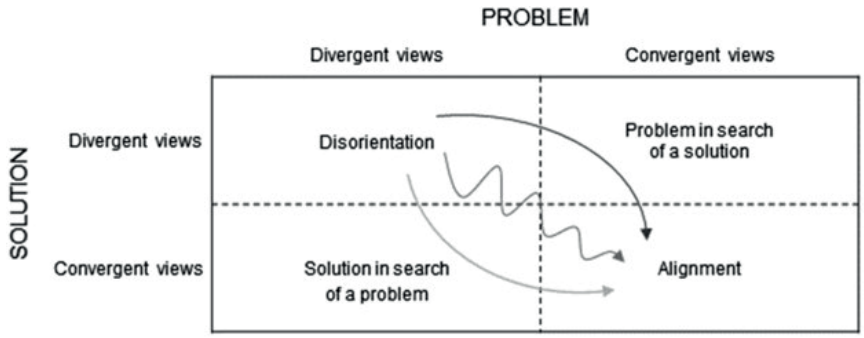

Figure 4 Different pathways for mission-oriented policies. Reprinted from Wanzenböck et al. (2020) "A framework for mission-oriented innovation policy: Alternative pathways through the problem–solution space" p. 484 (Creative Commons CC-BY license).

Directionality as situated deliberation: This notion of directionality focusses on the social evaluation and acceptance of socio-technical imaginaries as the desirability of innovation. Authors emphasize how groups, in specific regions and cultures, refer to different frames and realities through which they appreciate or contest innovation. Rather than highlighting directionality as a feature of systems of innovation or as a criterion for policymaking, it frames directionality as an unsettled and continuous deliberation regarding contingent pathways of socio-technical change. These deliberations unfold as innovation direction debates. In these debates, some groups are heard and others silenced. Directionality comes down to an ideal of just

deliberation, where pluralities of pathways are embraced by means of participation (wanted and unwanted) and other practices, as depicted in figure 5. This notion further contends that it is necessary to embrace the directionality of innovation as an uncovering of the irreducible plurality of imaginable pathways of change, and to use them to organize just decision-making.

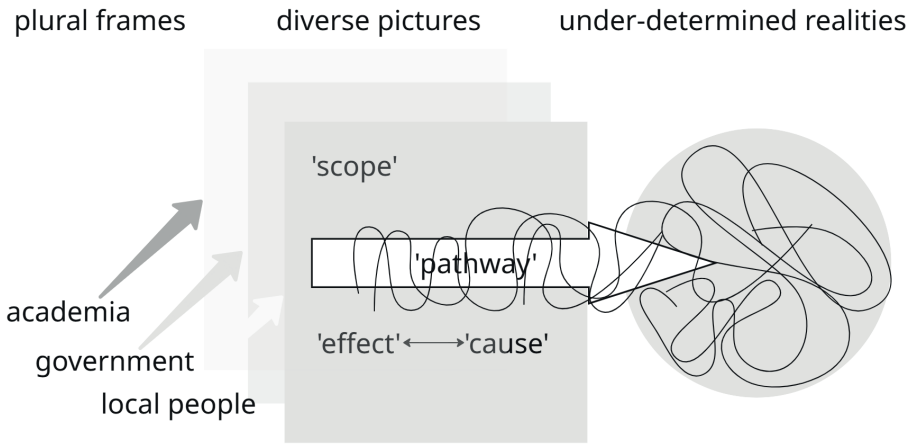

Figure 5 Adapted from Andy Stirling's slideshow "The Nexus": https://de.slideshare.net/slideshow/andy-stirling-nexus-methods/63905375.

With this overview of different ideal typical notions of directionality, it becomes clear that researchers use the term "directionality" differently. Some refer to socio-technical systems or systems of innovation. Others use it to analyze policy and yet others to capture social appraisal in situated deliberation concerning innovation directions. Of course, these different notions are ideal typical. In empirical contexts, they overlap and may influence one another. However, they are distinguished here for the purpose of a conceptual framing that allows for constructing a more delineated object of research for this dissertation (table 2).

Key concepts regarding directionality

Having fanned out and structured the breadth of the debate, the focus can now be directed towards the identification of relevant key concepts derived from the literature review. Table 3 presents and summarizes selected concepts and central points of discussion that are arguably essential elements of the directionality discourse. Thereby, I do not intend to provide definitions, but rather to describe key concepts in regard to their contribution to the study of directionality discourse.

Table 2 Overview of different ideal typical notions of directionality

Notions of directionality	Leading Question	Description
Directionality as a phenomenon in systems of innovation and transition processes	How do pathways and directions of socio-technical change come about?	• Focusses on innovation systems and transitions • Discusses desirability (normative directionality) vs. plausibility (positive directionality) • Investigates the dynamics of how desirable directions are formed • Studies the economic, political and socio-material characteristics of directions themselves
Directionality as a criterion for policymaking	How can policy promote and steer innovation towards specific directions?	• Focuses on design and assessment of policies • Studies how policies influence structural conditions (e.g. institutional, geography, market) to steer innovation • Highlights the importance of setting clear directions, consistent policy mixes and state capacities • Discusses top-down and bottom-up processes and how they implement directionality in policies • Emphasizes the need for targeted, measurable, and time-bound missions
Directionality as situated deliberation	To where do actors want to direct innovation and what pathways do they imagine and debate?	• Views directionality as a deliberative practice to debate directions, velocities and pathways of change • Focuses on social appraisal, acceptance and contestation of socio-technical change and the role of visions and imaginaries • Discusses how groups frame and contest innovation in pluralistic contexts • Aims to uncover the plurality and socio-cultural situatedness of pathways of change • Critically discusses restrictions to open deliberation such as cultural hegemony, vested interest and the exercise of power

Table 3 Selection of key concepts in the literature (in alphabetical order)

Key concepts	Short description
Directionality failure	The literature introduces new ideas about "failure" by building on existing concepts like "market failure" in economics and "system failures" in innovation research. Weber and Rohracher (2012), for instance, introduce the concept of transformational system failures, alongside, to address goal-oriented change. They identify two key failures: directionality failure (sometimes also termed orientation failure), which refers to the lack of a shared vision and particular direction of transformative change, and reflexivity failure, which emphasizes the need for continuous monitoring and adaptation to ensure progress toward transformative goals.
Grand challenges	According to the reviewed literature innovation policy is being reoriented towards addressing "grand challenges", also referred to as societal challenges. While some authors provide evidence that challenge-led innovation policy holds the potential to promote innovation for a 'better world', others posit that this new framing is overpromising and thus overburdening innovation policy. In any case, the authors agree that the challenge metaphor has become a powerful source of legitimacy for directional innovation policy.
Mission-oriented and transformative innovation policy	Mission-oriented policy (MIP) and transformative innovation policy (TIP) are the most visible manifestation of directionality in the form of policy approaches. While they differ in many regards and emerge from different academic fields, they both clearly link to directionality. The former emphasizes more the importance of top-down governance for formulating targeted, measurable, and time-bound missions, and the latter highlights niches and bottom-up processes to complement the policy-driven setting of a clear direction of change. Some authors point out that directionality did shape innovation policy also before the development of these two approaches, as prior research programs addressed the needs of sectors and followed specific goals. What is arguably new, however, is the focus on societal challenges for formulating directional policies.
Opening-up of innovation governance	A central point of discussions in the literature concerns an observed rebalancing from expert analysis toward participatory deliberation when discussing socio-technical choices. This debate explores how reflexive, inclusive or participatory approaches can help to open-up and uncover the plurality of directions for socio-technical change. While some authors show confidence in more inclusive governance frameworks, more participation does not necessarily result in enhanced accountability or better legitimization as both modes (expert or participatory) of discussing socio-technical choices are argued to be subjected to vested interest, the exercise of power and instrumental framing. In addition, opening-up is criticized in the literature as running into the risk of providing an easy fix for issues in innovation governance with questionable democratic legitimization.
Reflexive and anticipatory governance	The notion of reflexive governance is proposed in the literature to address the question of incorporating directionality and normative orientation into the systems of innovation approach. On the one hand, self-reflective practices, such as learning, monitoring, foresight, consultation and experimentation, are developed to provide feedback and guide innovation processes towards desired outcomes. On the other hand, reflexive governance also draws on the concept of reflexive modernization in sociology, which suggests that changes in practice can rebound on institutions and alter how they function.

Table 3 Continued

Key concepts	Short description
Spatial dimensions of directionality	The literature discusses spatial dimensions, including scales and levels, of directionality using a range of field-particular concepts, which here are subsumed under one umbrella. Prominent examples include the multi-level perspective, policy arenas, regional innovation cultures and geographies of missions. What these different concepts share in common is their understanding of innovation as situated in socio-spatial contexts. The literature elaborates on different geographic spaces and places as well as political and administrative levels alike, to explain how innovation directions and missions develop in interaction with different spatial contexts, how they pass through different arenas and how spatial issues such as the scalability of innovation have become a preoccupation for political and economic actors.
Systems of innovation	A central point of reference in the literature is constituted by the seminal works of Edquist, Lundvall and Nelson. According to the reviewed articles, the systems of innovation approach, developed by these authors and refined by the larger community of innovation scholars, has been central to explaining national, regional, technological and sectoral differences in innovation performance by emphasizing factors beyond the neoclassical economic framework. Moving beyond the concept of market failure, the approach has evolved to incorporate the concept of system failure, addressing issues such as infrastructure, skills, learning and institutional deficiencies. Next to neoclassical economy, the systems of innovation approach has arguably been one of the most influential paradigms in policy research and practice. The literature includes both critical reflections on the overly narrow focus of the approach on promoting and diffusing innovation, and conceptual refinements to consider the directions and ultimate societal goals that socio-technical change should serve.

Discussion: Conceptual framing

In this section, I build on the analysis of the discourse on directionality to draw implications for the conceptual framing of this dissertation. Relating the overarching research question of the dissertation to the notions of directionality identified in the scholarly discourse means to go beyond the epistemological portrayal of different notions engrained in the discourse and moving towards research that seeks to understand how directionality is ontologically enacted in practices (cf. Woolgar 2013). Thus, the conceptual framing follows the objective to delineate an original approach for studying directionality in the making. Before outlining this framing, I briefly recapitulate and discuss the findings of the literature review that justify it.

While directionality was until the early 2020s mostly a topic for evolutionary economists and political scientists in the fields of innovation and transition studies, the notion has been (re-)discovered by STS scholars as a research topic.

The interaction of researchers from different fields led to productive frictions consolidating and hybridizing the academic discourse on directionality, thereby leading to the emergence of different notions of directionality (directionality as a phenomenon in systems of innovation and transition processes, directionality as a criterion for policymaking and directionality as a deliberative, socio-cultural space). Furthermore, these interdisciplinary debates have had effects on the practice of innovation policy as it led to the development of new legitimacies, instruments and learnings.

The literature review has shown that several issues related to failure, directionality, and governance approaches are addressed in the context of transformative change. The literature introduces the idea of "directionality failure," referring to the lack of a shared vision for transformative goals. It discusses how innovation policy and systems of innovation are arguably being oriented towards addressing "grand challenges", with mission-oriented policies, transformative innovation policy and reflexive governance models focusing on directional change. The literature also discusses the opening-up of innovation governance, a shift from expert analysis to participatory deliberation, which is also grounded in experiments to establish new legitimacies for innovation policy. Additionally, spatial dimensions of directionality are explored, emphasizing how innovation evolves in different geographic, social and political contexts.

Identified research gaps in recent publications concern the spaces and practices for discussing innovation directions between policymakers and actors from science, technology and innovation. The literature review reveals a lack of research on how such interactional spaces emerge, how directional policies operate within concrete environments, how they can mobilize and coordinate action, and how they can bring about change (Janssen et al., 2021; Haddad et al., 2022). In this regard, research is urged to empirically scrutinize narratives, politics and feedback loops between different arenas and innovation actors (Janssen et al., 2023). Furthermore, the literature expects future research to explore the culturally situated interpretations, legitimacy and valuation of innovation (Haddad et al., 2022; Parks, 2022; Haddad and Bergek, 2023; Pfotenhauer et al., 2023). Thereby, it is argued that special attention should be paid to considering the democratic responsibilities and accountabilities necessary for responsible governance of innovation directionality (Stirling, 2024). This encompasses the empirical analysis of the opening-up of innovation governance (e.g. participation, consultation, foresight), as well as the interpretive closures and institutional stabilization of directions in strategic documents (e.g. setting of priorities and directions, formulation of missions) (Janssen et al., 2023; Stirling, 2024).

What these accounts have in common is an appeal to researchers to investigate the situated practices that enact directionality. The focus on practice is complementary to recent developments, wherein researchers have begun to analyze social phenomena, such as innovation and transitions, by engaging in empirical studies of practices. This line of research has provided novel insights and theoretical contributions, thereby exploring connections to predominant theories such as neo-institutionalism or transition theory (Spaargaren et al., 2016).

This dissertation adopts such a practice-oriented approach to study directionality in the making. Following a flat ontology it conceptually frames directionality as a 'large' phenomenon enacted by many, arguably, 'small' practices (Schatzki, 2016) of anticipating, discussing and testing of innovation directions that unfold at the intersection between policymaking, innovation activities and public appraisal of innovation directions. Rather than viewing these practices contained in one specific understanding of directionality, they are productive for all notions of directionality. This conceptual framing emphasizes the permeability of practices across divergent institutional contexts for directionality ranging from innovation to policy, to society. While practices are scattered, they eventually connect to each other through chains of actions and form a recognizable pattern across many instances in time and space, thus shaping directionality.

Practice theories have conceptualized such practice arrangements as the active integration of materials, competences and meanings (Shove et al., 2012). The distinctiveness of a practice depends on the combination of these three elements. In this regard, specific combinations bring about different practices shaping directionality. Directionality in the making, thus comes about as practices establish links between elements and other practices. Adopting the practice approach from Shove et al. (2012) and integrating it with the findings of the literature review, I propose the conceptualization of three relevant elements: Spatiality and materiality of directionality, know-how of directionality and meanings of directionality. These elements are linked by directionality in the making, i.e. a set of practices that shape and enact directionality. Figure 6 provides a schematization of directionality as the integration of elements through practice.

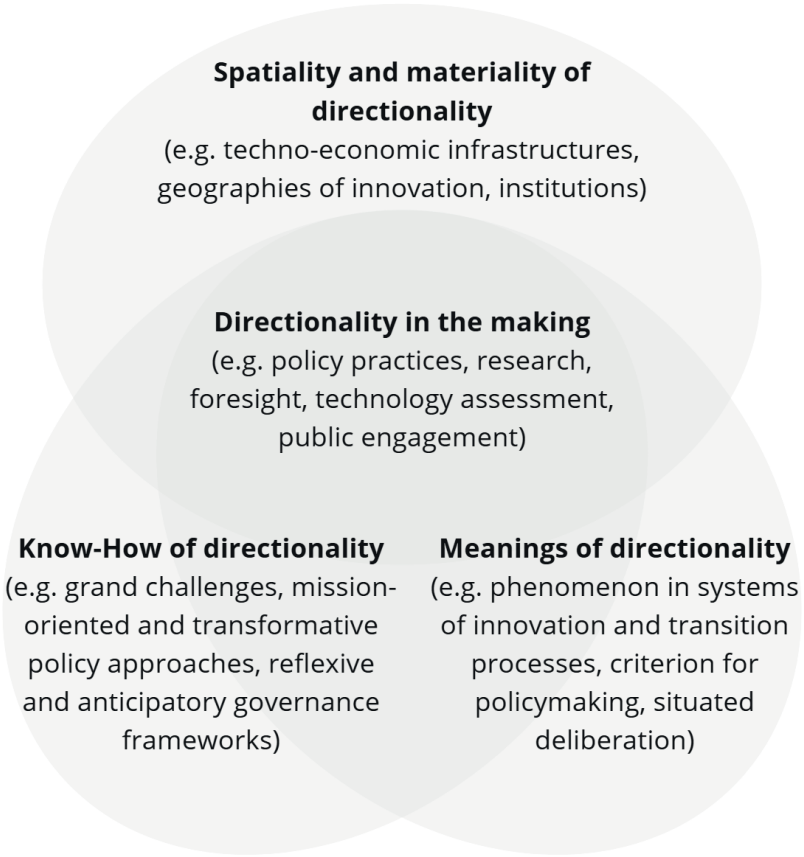

Figure 6 Directionality in the making: Conceptual framing based on Shove's et al. approach (2012)

Conclusion

The presented analysis aims to structure the directionality discourse. Reading it through the sociology of knowledge approach to discourse (Keller, 2011), it could be shown how an interdisciplinary domain of study emerged as priorly disconnected fields of research subsequently joined in a discursive arena problematizing directionality. The literature review has demonstrated the discourse's potential for bridging discussions in STS, innovation and transition studies, while simultaneously contributing to the theory and practice of innovation governance. Thus, epistemic interactions have influenced not only academic debates concerning innovation policy but have also shaped a specific politics of knowledge in the domain of innovation policy. As one effect of this, different notions of directionality have come to the

fore to vie for influence on the practice of innovation policy. While some emphasize political and economic choices in the development of socio-technical pathways, others highlight the structural conditioning of these pathways and yet others stress the importance of social appraisal and deliberation for governing socio-technical change in a pluralistic manner.

The increasing interest of STS scholarship on the topic has shown that directionality is not only a question for economists and political scientists studying systems of innovation and innovation governance but that it is also a phenomenon of sociological interest. Especially the research gaps identified in the literature and the proposals for future research show the need to scrutinize the practices that allow directionality to become socially performative, as a situated, inclusive and reflexive notion in the governance of innovation. It is exactly this conceptual framing of an unsettled and practice-bound phenomena that inspired the title *Directionality in the Making*.

Integrating these findings with practice theories, I developed the conceptual framing for researching directionality in the making. This framing conceptualizes directionality as the active integration of spatiality and materiality, know-how and meanings through specific sets of practices. These practices take place under different labels such as foresight, policy consultations and public engagement. They share in common that they initiate debates concerning the directions, pathways and velocities of socio-technical change. These innovation direction debates leverage anticipation, strategy and science. In this regard, the conceptual framing of this dissertation can be complemented by existing concepts from STS scholarship that seek to understand how articulations of the future are mobilized in the context of innovation direction debates (Borup et al., 2006; Alvial-Palavicino, 2015; Oomen et al., 2021). Chapter 4 explores these concepts, develops an anticipatory practice approach to complement the overarching conceptual framing and provides empirical insights into the composition of concrete practices at play.

3. Research design

This chapter introduces the research design, which was developed and iteratively refined for the empirical study of directionality in the making. In line with the conceptual framing, the research design goes beyond addressing the generic notion of directionality as setting of directions and goals of innovation policy. Rather, the practice-oriented understanding of directionality emphasizes how deliberative practices link meanings, know-how and materiality of directionality. Operationalizing this focus for empirical research means to find ways to study practices through which innovation directions are anticipated, explored, discussed and appraised while paying attention to the material and institutional contexts in which these practices unfold. These practices cover a continuum from policy practices to foresight to public engagement.

This dissertation focuses on the practice of foresight and its interaction with policy and public engagement. The research follows foresight practices as an expression of directionality in the making. Practices under the label of foresight qualify as an object of research because of three reasons: Firstly, foresight has seen considerable institutionalization in the context of innovation policy. It is used by state actors to inform and direct policies and is promoted as a central feature in many dominant policy approaches. Secondly, foresight presents itself as a future-oriented practice. In contrast to forecasting, it aims to explore alternative future development pathways for "strategic conversations" emphasizing the openness of the future. Thirdly, foresight embraces participatory deliberative practices. It attempts to bring together expert advice with social appraisal through public engagement. Another advantage of following foresight practices as an expression of directionality in the making is that foresight often encapsulates a comparatively broad scope. Instead of focusing on a specific technology, innovation activity or piece of policy, the focus on foresight allows to connect findings from scattered policy initiatives in diverse settings. Thus, the overarching research question is formulated as *How is directionality practiced through policy-oriented foresight across different contexts?*

Research strategy

To answer this question, a qualitative case study approach was adopted. Given the diversity of conceptions in social science research regarding what constitutes a "case", it is important to explicate what adapting a case study design means in the context of this dissertation (Ragin and Becker, 1992). While the objective was not to treat cases as comparable instances of the phenomenon of directionality, the research design aimed to explore specific, situated and bounded practices across different types of empirical units to then generalize observations and findings (cf. "cases as objects" – ibid. chapter by Vaughan). Building on the conclusion of the literature review, which

emphasized the need for empirical studies on practices that unfold through various arenas at different scales and levels, the cases were selected to represent a diversity of contexts while maintaining relevance to the explanandum of directionality. Several organizational and project contexts constituted these empirical units.

Briefly put, the dissertation focused on three cases that provided the context for qualitative in-depth studies: Firstly, a foresight process that aimed to support innovation policymaking at the level of the European Commission. Secondly, a participatory foresight process at the intersection between the German Federal Government's so-called High-Tech Strategy and regional innovation activities. Thirdly, foresight-policy interactions within the German Federal Government.

Choosing Europe and respectively Germany as the geographical contexts in which these cases are embedded, was in parts deliberate research strategy and in parts an effect of personal involvement. On the one hand, innovation policymaking in both the European Commission and the German Federal Government represents prominent examples for mission-oriented and transformative approaches as well as for the embedding of or experimenting with participatory, reflexive and anticipatory practices. On the other hand, in-depth empirical research depends on field access for research. My involvement as a researcher in a large German research organization allowed me to extensively gather material through projects in this European context (future research will seek to go beyond this Eurocentrism, see Chapter 7).

The following provides a brief overview of the contexts relevant for this dissertation. Based on this description, I introduce the specific research questions and case studies embedded in this empirical context. Subsequently, I provide insights into the main methods of data collection and analysis. At the end of this chapter, the chapters are outlined, and their connections are highlighted.

Description and selection of cases

In the following, I present the case descriptions and explain how they connect to the identified research gaps and the research questions of this dissertation. Presenting the cases in the order of initiation, circulation and uptake of policy-oriented foresight practices allows for illustrating how directionality debates, concerned with the directions, velocities and pathways of innovations, are triggered and moved through different arenas and eventually return as feedback to policy arenas. While this order illustrates how the chapters are linked to support a coherent narrative for the dissertation, it does not imply a linear causality in which directionality debates evolve from the supranational to the national to the regional level. The argument is

not that directionality debates follow a chronological or hierarchical order. Quite the opposite: the chapters presenting the case studies demonstrate that these processes often unfold simultaneously, showing that the making of directionality is an unsettled, asynchronous process that evolves across scattered spaces.

Foresight in the context of Horizon Europe

The Ninth Framework Programme for Research and Innovation of the European Union, Horizon Europe (running from 2021 to 2027), aims to boost Europe's competitiveness while addressing grand challenges. It directly links to the UN's Sustainable Development Goals and has operationalized a mission-oriented approach, which targets specific societal challenges with measurable goals. The five missions build on first experiences made during the preceding Framework Programme, Horizon 2020, which had initially incorporated grand societal challenges into its agenda. However, Horizon 2020 faced challenges in fully addressing these complex issues due to its reliance on established structures, limiting its ability to coordinate and foster necessary collaborations across different sectors and disciplines. Drawing from the lessons learned in the design and implementation of its predecessors, Horizon Europe aims to enhance collaboration among EU member states, research institutions, industry, and civil society, while simultaneously accelerating socio-technical change in specific directions.

While the mission concept has generated significant interest and momentum among policymakers, its implementation, within the given timeframe, has been described as a challenge (Janssen et al., 2023). One part of the response to this challenge consisted of various foresight activities that aimed to inform and direct policymaking. Concretely, a foresight study (BOHEMIA) drew together discussions from different expert groups, public engagement and scenarios to support the design of Horizon Europe. During the initiation and early implementation of the mission through expert groups, so-called mission boards, another foresight process (Foresight on Demand) supported experts in formulating missions to account for different future scenarios, coalescing expectations of different epistemic communities and stakeholder groups, as well as roadmapping of various mission activities and milestones.

Based on the identified research gap, namely the lack of empirical studies concerning practices that facilitate directionality, the context of foresight activities supporting the design and implementation of Horizon Europe provided a solid case for addressing the following specific research question:

*How does foresight initiate discussions regarding the directionality of innovation policy?*Given the EU's role as an ambitious frontrunner regarding innovation policy, selecting a case embedded within this context promised to add further relevance to the research. The case study focusses on the Foresight on Demand (FoD) framework contract which encompassed over 30 projects that were carried out by a consortium of 14 partners between 2019 and 2024 (and the contract was renewed until 2028). FoD was selected as a case because all its constituent projects facilitated policy-oriented foresight. Furthermore, FoD was situated in the context of several other foresight projects, expert groups and public consultations. While my colleagues were directly involved as researchers in FoD, I engaged as an observer with the project. The results of this research were submitted for publication in October 2024 and can be found in Chapter 4.

Public engagement in the context of the German High-Tech Strategy

The German High-Tech Strategy (HTS) was developed in the early 2000s as a response to the emergence of novel socio-technical systems, increasing international competition in times of accelerating globalization and the perception of an "innovation deficit". As Germany aimed to strengthen its competitive edge in key industrial sectors, a recognition of the need for a more coordinated and comprehensive approach to innovation policy was promoted. This shift was also influenced by the growing fragmentation of Germany's research and innovation system, particularly in the context of its federal structure, which divided responsibilities between various ministries, research institutions, and regional governments.

The HTS evolved over several governments. In an important iteration in 2010, a shift from a narrow focus on technological advancement to a broader commitment to addressing societal challenges was facilitated. The new rationale was supported by multiple foresight processes, most notably the so-called "foresight cycle". By the mid-2010s, the strategy had further developed with the development of the "HTS 2025", which introduced a mission-oriented approach encompassing transformer and accelerator missions (Wittmann et al., 2021). This included the formulation of twelve missions across three key areas: technological development, health, and sustainability. These missions embodied a shift toward a more transformative approach to innovation, emphasizing collaboration across sectors, regions, and levels of government. In addition to the foresight cycle, future-oriented, participatory dialogues were held in different regions to strengthen collaboration between different levels and scales.

The public consultation process for the German High-Tech Strategy 2025, commissioned by the Federal Ministry of Research and Education, resulted in

seven regional dialogues in 2020. It provided a case for studying another research gap, namely the lack of research on the scales and levels of directionality debates. Therefore, we studied the multi-sited interaction between actors from different levels and scales that came together to make sense of Germany's innovation and research strategy. This case study followed the specific research question:

How does directionality connect to different spaces? The participation process, along with a follow-up interview study conducted in 2022, provided insights into why and how civil servants at the federal level seek consultations with a wide range of actors in local innovation ecosystems. The study also explored how these local actors interpret specific innovation ambitions, and to what extent this feedback contributes to reflexive learning in the formulation and implementation of policy. In 2024 the results of this case study, which can be found in Chapter 5, were published as an original research article in a special issue on the geography of missions in Environmental Innovation and Societal Transitions.

Foresight-policy interactions in the German Federal Government

The first and second case studies illustrate how public administrations initiate and circulate innovation direction debates through commissioning foresight projects. While both cases provided the context for studying how knowledge, actors and expectations are mobilized, how the practice of foresight unfolds and how it is involved in the making of publics for directionality, the cases spurred new relevant questions. How does the future-oriented appraisal of socio-technical change, its direction, velocity and pathways, relate back to the state, its administration and policymaking? Of course, the official rationale of the studied foresight processes has always emphasized producing reflection, learning and feedback for policymaking. However, rarely it has been investigated how policymakers understand, value and deduce strategic implications from directionality debates.

Hence, the third case study was born out of questioning how the state and its public administration interact with foresight, how they absorb feedback from the heterogeneous actors and scattered spaces in which directionality debates unfold and whether this can influence the setting of policy directions. The adoption of foresight within the German Federal Government provided an insightful case for studying how policymakers understand, value and interact with future-oriented practices aimed at fostering directionality. This research is based on an in-depth interview study with civil servants from across all ministries, which was commissioned by the German Federal Chancellery in 2021. It aimed to investigate the institutionalization of foresight in the German Federal Government. The research team interviewed over

thirty civil servants and organized subsequent discussion groups with policymakers and academia to reflect the results. Chapter 6 presents the findings of this research, which were published in Futures & Foresight Science in 2024.

My position in the field

Qualitative data and material are at the core of this dissertation. Without my affiliation as a researcher at the Fraunhofer Institute for Systems and Innovation Research (ISI) I would not have had the opportunity to access the sites, workshops and institutions where I collected this data. Since 2020, I have researched at the institute's Competence Center Foresight, which allowed me direct involvement in dozens of different foresight processes. In this context, I learned from and with colleagues to implement a broad variety of policy-oriented foresight activities. This meant hands-on training on how to apply structure, reflexivity and creativity to organize strategic and forward-looking conversations.

Perhaps it was the exceptional conditions in the midst of the global COVID-19 pandemic that made me ponder the reasons, actions and legitimacy of this practice. To me, it felt utterly absurd to engage people in discussions about the future of technology and innovation via laptop cameras on their kitchen tables, while they, and I, were occupied caring for our children and loved ones in a situation that was both distressing and boring at the same time. Maybe it was also my sociological background that made me wonder what was actually going on in the foresight conversations.

Starting from June 2021 onwards, I was offered the chance to take a step back from doing foresight, to reflect what foresight was doing. As an external PhD candidate at the Institute for Science in Society of the Radboud University I was encouraged by my supervisors, fellow PhD candidates and colleagues at ISI to revitalize my sociological background and deep dive into STS scholarship. Simultaneously, I continued with the Competence Center Foresight, and took part in project meetings, workshops and internal discussions.

Consequently, I did not maintain a static position. Instead, my doctoral research can be understood as a case of constant boundary spanning between STS, innovation studies, policy studies, and the practice of foresight. Rather than being asked to clearly delineate my position, my supervisors cautioned me not to develop an academic identity conflict out of the shifting positions and encouraged me to see the frictions as inspiration for my research, not a problem.

The four years of research that followed were marked by alternating moments of involvement and detachment (Elias, 2007). On the one hand, this approach provided the chance to develop a practical understanding of foresight, i.e. to reflect and sharpen specific research questions in direct contact with practice. On the other hand, my ambivalent position as both a practitioner, collaborator and an observer posed additional methodological questions as they are being recurrently discussed in the contemporary literature on social scientific research and ethnographic STS dissertation projects (Engels, 2020; Estalella and Sánchez Criado, 2021). Where is the boundary of research and where is the researcher's position? Drawing from the idea of engaged scholarship (Herberg et al., 2021), I learned to see my research as an epistemic practice that constructs a field to bound a studied phenomenon.

Data collection

In accordance with the practice approach taken in this dissertation, data collection followed practice-oriented approaches for document analysis, interviews and focus groups and ethnographic approaches for participant observation in workshops (Shove et al., 2012; Spaargaren et al., 2016; Wenzel et al., 2020; Estalella and Sánchez Criado, 2021; Herberg et al., 2021; Asdal and Reinertsen, 2022).

Following this approach, nearly fifty interviews were conducted, more than thirty policy documents were extensively analyzed and more than two dozen workshops and focus groups were implemented. Establishing this rich corpus would not have been possible without the collaboration with my colleagues at ISI and the involvement of my daily supervisor. The combination of specific material and data used in each chapter slightly differs. Table 4 provides an overview of the specific sets of data and material gathered from each case study and used in each chapter. Given the potential sensitivity of often work-related interviews, all interviewees signed an interview consent form that guarantees that the interview data is stored safely, not circulated and anonymized.

Table 4 Material and data collected during dissertation

Material and data used per chapter / case study	
Chapter 4	• One focus group • Seven in-depth interviews with foresight practitioners and EC civil servants • Retrospective auto-ethnography • Practice-oriented document analysis of official Horizon Europe documents and meeting minutes
Chapter 5	• Participant observations in seven regional dialogues and dozens of project meetings • Eight interviews with civil servants and local hosts as well as participants • Document analysis of High-Tech Strategy documents, High-Tech Forum reports, core messages and meeting minutes
Chapter 6	• Thirty-one in-depth interviews with civil servants of federal ministries • Document analysis of international and national foresight toolkits, guidelines and handbooks

Data analysis

The recordings of interviews (lasting between 45 and 120 minutes) and notes of workshops were transcribed and analyzed using MAXQDA. This software for interpretive analysis of text helps to condense, compare and interpret data and materials. In this process, I departed from Grounded Theory's prescription, or to put it more drastically, it's "epistemological fairytale" (Wacquant, 2002, p. 1481) that coding should start by inductively constructing small codes with no connection to prevalent literature. While the very first steps of analyses followed a largely inductive approach (Corbin and Strauss, 2008), the findings from the literature review and the consolidation of the conceptual framing became so prevalent that many codes were constructed through deduction.

Thus, I decided to move to a more flexible approach to coding. Flexible coding (Deterding and Waters, 2021) presented itself as a suited approach. It allowed for working with 'bigger' index codes that reflected and connected to interview protocols, previous studies and prevalent theories (ibid). The adoption of this approach resulted in the iteration of development of codes, the discussion of tentative analyses, and the integration of feedback (from the research group, conferences and review processes). This flexible tacking back and forth between data, concepts and articles became the modus operandi for data analysis in the context of a cumulative PhD thesis. In addition, flexible coding proved to be a more timely way of coding material and data with qualitative data analysis (QDA) software allowing for distributed teamwork.

The following chapters will elaborate on these points regarding methods and data analysis. These descriptions will pay particular attention to adjusting the overarching research design to the specific contexts and research questions of each case study.

4. Setting the Scene for Discussing Innovation Policy Directions: Foresight as a Practice of Synchronizing

An earlier version of this chapter was published as an article:
Priebe, Max; Warnke, Philine; Weber, K. Matthias (2025):
Setting the scene for discussing innovation policy directions:
Foresight as a practice of synchronizing. In: Futures 173, 103681.
DOI: 10.1016/j.futures.2025.103681.

Abstract

Researchers and policy analysts often highlight the role of anticipatory practices in technology development and innovation governance. In this study, we extend this argument by examining foresight practices within the context of initiating deliberations concerning the directionality of innovation policy. Drawing on practice theories and anticipatory practice research, we develop a conceptual approach to scrutinize foresight. The lens is applied to study the case of a large policy-oriented foresight scheme, Foresight on Demand, which supported the operationalization of Horizon Europe, the Ninth European Framework Programme for Research and Technological Development. This case study provides insight into the workings of anticipatory practices during the nascent stages of innovation policy processes, when problems, solutions and stakeholders' interests have yet to be fully defined. The study describes how foresight mobilizes actors at the intersection between innovation, policy and society through engaging them with anticipatory practices. We conclude that foresight hereby synchronizes disparate bodies of knowledge, collective expectations and temporal demands, thus 'setting-the-scene' for arenas in which actors can, in spite of functional differentiation, get together and discuss innovation policy directions. The research findings outline possible implications for function, utilization and evaluation of foresight.

Keywords: *foresight, practice theory, anticipatory practices, innovation policy, directionality*

Introduction

The future does not exist, it is produced and enacted. Historians and social scientists have demonstrated that future-making practices constitute an essential aspect of social life in modernity (Adam & Groves, 2007; Hölscher, 2016; Koselleck, 2005; Reckwitz, 2016). The growing recognition of the future as an unknowable category in organizations has led to a diversification of anticipatory practices overriding, sidelining or supplementing once dominant planning practices (Wenzel et al., 2020). In the context of science, technology and innovation policy (STI policy), as a field with a particularly strong future orientation, anticipatory practices play a crucial role (Aykut et al., 2019; Borup et al., 2006; Robinson et al., 2021; van Lente, 2012).

With policies aiming to contribute to specific directions of change, states have invested in increasing their capacities to shape directionality and increase "strategic intelligence" (Robinson et al., 2021). How this is done in practice, is subject to a growing, but still small body of literature (Haddad et al., 2022). This lack of empirical research on the role of anticipatory practices for preparing, implementing and revising innovation policy is surprising as the latest modes of innovation governance, such as mission-oriented policies (Janssen et al., 2021; Wanzenböck et al., 2020), transformative innovation policy (Schot & Steinmueller, 2018; Weber & Rohracher, 2012) or debates concerning technological sovereignty (Edler et al., 2023), all point to a renaissance of the state as an important orchestrator of innovation. In this regard, the chapter aims to respond to the following specific research question: How do specific foresight practices initiate debates regarding innovation directions and the directionality of innovation policy during the process of agenda and priority setting?

While methods, intentions and results of foresight processes are well documented in the literature, only few studies have made policy-oriented foresight their object of research and studied “foresight in action” (van ‘t Klooster et al., 2024; van Asselt & van't Klooster, 2015; van Lente, 2012). Instead, many conceptual framings overemphasize cognitive capacity, creativity or literacy running the risk to obfuscate what foresight does. In this chapter, we argue that foresight is first and foremost defined by practice (Da Costa et al., 2008, p. 370). Lacking a commonly shared theory (Fergnani & Chermack, 2021), foresight builds on a community-of-practice that develops participatory and structured dialogues or “strategic conversations” to articulate and reflect socio-technical futures (Bowman, 2022; Cuhls, 2003; Rosa et al., 2021; Spaniol & Rowland, 2019; van der Heijden, 2009).

We argue that conceptually framing foresight as practice draws attention to how knowledge and expectations are mobilized for policy arenas, thereby allowing for novel insights. To illustrate this point, the chapter presents a case study. We reconstruct the European Commission's "Foresight on Demand" framework contract (FoD) from a practice-theoretical approach (Hui et al., 2017; Schatzki et al., 2001; Shove et al., 2012). Studying the before, during and after of FoD, we reconstruct a chain of actions that made foresight travel as a concept, inscribed it into a tender, described it in a proposal, scoped it in meetings, facilitated it through workshops, questionnaires and scenarios and finally connected it to the recursive intersections of STI policy and society.

Before introducing the anticipatory practice approach used to guide the empirical research, we first elaborate on the implications of foregrounding practice theories. Subsequently, we present the methods and materials employed in the case study chosen to illustrate the practice approach. The results section provides a brief genealogy of the institutionalization process that has shaped the foresight practice in the European Commission, describes the unfolding of activities connected to FoD and outlines chains of action that have superseded the delineated project contexts. The discussion combines the various observations to construct an argument regarding the practice of foresight as a process of synchronizing knowledge, expectations and temporal demands. The chapter concludes by proposing that the concept of synchronizing, as a research outcome, can contribute to understanding how foresight sets the scene for policy arenas in which innovation policy directions are negotiated.

Conceptualizing anticipatory practices

Practice theory

The so-called practice turn in the social sciences has been the source of original insights in a variety of disciplines over the past two decades (Spaargaren et al., 2016). Despite diverging conceptualizations of 'practice' and different theoretical stances explicating the relations between practice and the workings of society, what unites diverse practice approaches is a striking clarity concerning their object of research. They share the assumption "that practices consist in organized sets of actions, that practices link to form wider complexes and constellations – a nexus – and that this nexus forms the 'basic domain of study of the social sciences' (Giddens, 1984: 2)" (Hui et al., 2017, p. 1). Inspired by the foundational work of social theorists and sociologists such as Pierre Bourdieu, Anthony Giddens, Andreas Reckwitz, Theodore Schatzki, Elizabeth Shove and Annemarie Mol, practice-theoretical accounts aim to challenge

reductionist explanations and establish a middle ground between individualistic and structuralistic accounts of the social.

Theodore Schatzki has brought theoretical thought from philosophy, geography and sociology into a conversation and has hitherto developed one of the most influential accounts of practice-theory. For Schatzki "the social is a field of embodied, materially interwoven practices" (Schatzki, 2001, p. 3). He proposes to understand practices, both doings and sayings, as the smallest unit of the social that structures sociality at large, i.e. its fields, discourses, and identities, but also its presumed micro-foundations such as represented in the notion of agency. Thus, practice theorists conclude that "there is nothing beyond 'the level of social practices'" (Spaargaren et al., 2016, p. 14). This assumes that practice theory evolves on the basis of a "flat ontology", hence denouncing structuralistic ways of interpreting social phenomena.

Elizabeth Shove, takes this idea a step further by emphasizing the recursive character of practice, which does not merely play out at the level of individual habit but "… endures between and across specific moments of enactment" (Shove et al., 2012, pp. 6–8). Thus, she concludes that recurring 'practices-as-performances' shape a "recognizable conjunction of elements, consequently figuring as an entity" (ibid, p. 7). Rather than theoretically centering the individual as an actor, she suggests thinking of the individual as a carrier of practice, as a practitioner (ibid.). As a result, theories of practice do not frame people as actors, that is, as the sole starting points of practice, but instead ask how practices recruit practitioners or how activities 'befall' people (Schatzki, 2019, p. 12). While Shove argues that focusing on recurrence of practices is crucial to understanding how social life is stabilized and reproduced, practice scholars also emphasize the importance of refining theories of practice to more rigorously address social change and 'large phenomena' (ibid., p. 8; Hui et al., 2017; Schatzki et al., 2001; Shove et al., 2012; Spaargaren et al., 2016).

Practice research has contributed to the development of scientific discourse and extensive body of knowledge on the question of how policy seeks to shape everyday-life social practices (e.g. Shove et al., 2012; Spaargaren et al., 2016). In the remainder of this chapter, we turn the question upside down and follow the anticipatory practices that shape innovation policy. We aim to gain insight into the workings of anticipatory practices during the nascent stages of policy processes, when, problems, solutions and stakeholders' interests have yet to be fully defined.

From social practice to anticipatory practice

Acts of anticipation have always played a pivotal role in human societies (Hölscher, 2016; Koselleck, 2005). Sociological research has provided insights into the processes of rationalization, scientification and professionalization that led to a diversification of anticipatory practices (e.g. Adam & Groves, 2007). This goes way beyond planning. In the context of late modernity, as argued by social practice theorist Andreas Reckwitz, the planning model of managing the future recedes into the background (Reckwitz, 2016). He posits that late modern societies are particularly prone to shift from routinized control and planning regimes that condense and order time to rather creative anticipatory practices that view the future as an ever-evolving, multifaceted domain of possibilities. Following on from the control-oriented future-making practices of industrial modernity and the risk-oriented practices of Ulrich Beck's "second modernity", Reckwitz ascertains a contemporary emphasis on the effective exploration of coincidences and uncertainties, which, he argues, is seen as a crucial skill to be cultivated in organizations (Reckwitz, 2016, p. 133).

The development of such a skill, or capacity for anticipation (Guston, 2014), evolves around very concrete practices. A multiplicity of formalized and informal practices produce, reflect and (de-)stabilize collective expectations and imaginaries. On the one hand, these practices become socially performative shaping the way we act on the future through myriads of strategies, roadmaps and missions (Alvial-Palavicino, 2015; Jasanoff & Kim, 2015). On the other, as practices turn expectations into documents and material arrangements, these products become performative themselves (Oomen et al., 2021).

Anticipatory practice research

Against the backdrop of newly emerging practices of anticipation in the context of science, technology and innovation, STS research has become at the same time influential for and inspired by the theoretical developments in practice theory. Anticipatory practice research is one of the specific fields of research in which this interplay has taken place. At the outset of anticipatory practice research lies the question of how the future is configured as an object of inquiry and how it informs acting in the present. While the research landscape is diverse and a plurality of anticipatory practices have been scrutinized, some themes have been particularly salient.

One prominent theme of research on anticipatory practices has been modeling and scenarios in the context of climate and environmental policy (Aykut et al., 2019; van Asselt & van't Klooster, 2015). In this regard, anticipatory practices appear as highly formalized techno-scientific knowledge practices (Aykut et al., 2019). While

these anticipatory practices have arguably played a significant role in shaping policies, they have also been subject to criticism. It is argued that these anticipatory practices risk a depoliticization of decision-making in policy (Aykut et al., 2019; Voß & Amelung, 2016). Furthermore, techno-scientific modeling has been critiqued for reducing contingent visions of the future to model-based descriptions of tentatively putative future climates (Hulme, 2011). Consequently, research has also shed light on how scenarios can be co-created on the basis of exchange between modelers and stakeholders (Wachsmuth et al., 2023). This indicates that anticipatory practices entail not only producing and managing knowledge but also evolve around acts of their translation, interpretation and contestation.

The second prominent theme is constituted by the sociology of expectations, especially research concerning the shaping of collective expectation in technology developments (Alvial-Palavicino & Konrad, 2019; Borup et al., 2006; Konrad, 2006). This line of research has conceptually distinguished anticipatory practices as practices that shape uncertain, non-immediate futures and mobilize actors' expectations (Alvial-Palavicino, 2015). Thereby, they highlight that expectations are not about the truthful validity of a claim, but about how they structure doings, i.e. how hypes (van Lente, 2012) or visions (Ferrari & Lösch, 2017) legitimize investments, provide direction and contribute to coordination. Building on this line of research, the practice-oriented concept of "techniques of futuring" (Hajer & Pelzer, 2018; Oomen et al., 2021) goes further to emphasize that structuring effects of collective expectations can be (re-)configured by practice. Techniques of futuring create meanings, relations of trust and legitimacy thereby becoming socially performative, shaping collective expectations and actors' orientation for action (Oomen et al., 2021). In contrast to the critique regarding techno-scientific practices closing down the openness of the future, anticipatory practices may also appear as deliberative practices for the exploration of alternative directions (Stirling, 2008, 2024).

A third theme that is salient in research on anticipatory practices is strategy. Under the label of "strategy as practice" (Golsorkhi et al., 2015; Orlikowski and Scott, 2015) research has been dedicated towards studying practices such as strategic planning, meetings and workshops in private and public organizations. Management scholarship has discussed strategy as a set of formalized practices and social practices that intently or unintentionally shape the directions, trajectories and objectives pursued in organizations. Thereby, strategizing in organizations is faced with a multiplicity of unexpected events and uncertain future developments that create diverging temporal demands (Blagoev and Schreyögg, 2024, p. 2). Anticipatory practices address this temporal complexity by suggesting condensing, aligning and

ordering time. From this perspective, roadmapping, for example, not only shapes collective expectations but also sets the internal rhythm of activities, determining the pace and timing of actions, as well as how work is synchronized or decoupled. On the other hand, scenario planning facilitates strategic responses for either delaying or accelerating reactions to external temporal demands. Research has critically examined the industry of making and selling strategy tools, contributed to understanding the involved anticipatory practices and shed light not only on intended outcomes at the organization level but also overarching questions of legitimacy, power and politics (Jarzabkowski and Kaplan, 2015).

To sum up, anticipatory practices are studied in various contexts, from policymaking and technology development to organizational strategy. Thereby, research has focused on a variety of anticipatory practices, underpinned by different anticipatory heuristics (Urueña et al., 2021), which do not manifest exclusively as purposefully designed approaches, clearly labeled methods and discrete processes (e.g. modeling, roadmapping, scenario), but also as informal, rather implicit articulations of the future in everyday work practices (van Lente, 2012; Sarpong et al., 2013). In this regard research has also shown how anticipatory practices have become reflexive in the sense that they problematize existing hypes, assumptions and future expectations (e.g. van Lente, 2012). In the following we propose integrating the perspectives offered by these different lines of research for studying policy-oriented foresight. We argue that existing studies offer largely complementary perspectives, emphasizing practices of knowledge production, shaping of collective expectations, and strategic timing of organizational action. An integrated approach on anticipatory practice has the potential to unpack how foresight initiates discussions concerning the directions and pathways of socio-technical change, thereby corroborating the intersections between STI policymaking, organizational contexts and society.

Foresight as an anticipatory practice

The literature on policy-oriented foresight defines it as a systematic process through which possible future can be articulated and explored (Da Costa et al., 2008; Robinson et al., 2021; Schoen et al., 2011). Although foresight processes may connect to techno-scientific anticipatory practices such as modelling, foresight practitioners frequently emphasize the difference between forecasting and foresight (Cuhls, 2003). Instead of aiming to identify the most likely future, foresight is about co-creating plausible futures through practices of deliberation, participation and engagement (Cuhls, 2003; Gudowsky & Rosa, 2019; Guston, 2014; Rosa et al., 2021). Thus, foresight is framed as a structured dialogue and "strategic conversation" (Bowman, 2022; Spaniol & Rowland, 2019; van der Heijden, 2009).

Foresight can fulfill different functions for policymaking (Da Costa et al., 2008) and ultimately aims to support strategic intelligence, reflexive capacity and aid decision-making (Guston, 2014; Robinson et al., 2021). Despite efforts to formalize foresight training through toolkits, university curricula, associations, journals and conferences, foresight does not (yet) constitute a fully institutionalized epistemic community that could present itself as an independent academic discipline. Therefore, foresight is described as a community of practice constituted by individuals from a variety of professional backgrounds who commonly share and discuss method designs, use cases and learnings (van 't Klooster et al., 2024). Rather than being characterized by a common epistemology, scientific theory or formalized norms (Fergnani & Chermack, 2021), foresight is defined by practice (Da Costa et al., 2008, p. 370). This is relevant for both foresight practitioners and their clients, as active participation in foresight processes is considered just as important as utilizing the final product (van Asselt & van't Klooster, 2015, p. 29). Consequently, the investigation of foresight from a practice perspective can be considered a well-suited approach. But how then can we concretely discern, study and analyze foresight as a set of anticipatory practices?

Following Spaargaren et al. (2016, p. 232), we suggest to focus research on three aspects. First, we build on the practical understanding of foresight practitioners to identify and describe the practices considered relevant for foresight. For this purpose, the insights from anticipatory practice research can be integrated to guide the identification. Thus, attention has to be paid to practices shaping the production and management of future-oriented knowledge, the mobilization of collective expectations and techniques of futuring, and the strategic timing of organizational actions. This requires attention to the carriers of practice, observing and reconstructing their working practices and understanding the social construction of meaning therein. While anticipatory practices are central to understanding foresight, the two terms should not be used interchangeably. Some anticipatory practices are essential for foresight (e.g. scenarios), others are exercised under different labels and link only seldomly to foresight (e.g. predictive analytics).

Second, we focus the research to elucidate the embeddedness and material arrangements connected to foresight. The material context in which anticipatory practices unfold is not merely a backdrop. Infrastructures, artifacts, instruments, and other entities facilitate the enactment of specific practices while they can constrain others (e.g. online workshops). Simultaneously, anticipatory practices shape the material context by inscribing themselves into objects and documents that aim to order expectations and actions in time (e.g. roadmaps or strategies).

Third, we argue that a practice approach to studying foresight should pay attention to the historical developments of foresight as a practice. This includes explaining how practices were shaped and circulated before they eventually became adopted. In this regard, it is also crucial to elucidate the connections between foresight and other practices at the intersection of innovation, policy and society.

The study of policy-oriented foresight, therefore, involves the investigation of the mobilization of knowledge, expectations and strategic considerations in policy contexts prior to or during agenda-setting, when problems, solutions and stakeholders' interests are still in flux. In this regard, foresight practices take place next to, and at times interact with, a myriad of forces shaping agenda-setting such as lobbying, political maneuvering and partisan interests. The study of policy-oriented foresight needs to take the role of these competing influences into account, in order to avoid over-stressing the role that foresight plays. Table 5 summarizes the conceptual framing of foresight as anticipatory practice with the aim to help organize research as illustrated in the case study section.

Table 5 The anticipatory practice approach for studying foresight

Aspects of foresight	Focal points for research
Anticipatory practices	• Production and management of future-oriented knowledge • Mobilization of collective expectations and techniques of futuring • Strategic timing of organizational actions
Material arrangements	• Infrastructures and material conditions in which foresight takes place • In- and description of foresight through documents and artifacts
Historical development	• Circulation of foresight • Adoption and non-adoption of specific practices

Materials and methods

The following section presents a case study that employs the conceptual framing developed in the previous section to gain insight into a specific case that unfolded from 2019 to 2024. This case involved the implementation of over 30 projects, which were conducted by a consortium of 14 partners, research organizations, and foresight consultancies, collectively operating as the Foresight on Demand (FoD) consortium within a framework contract with the European Commission (EC). Recently, this framework contract has been renewed for another four years, ensuring the continuation of this work until 2028. The FoD case offers several insights that are relevant to our research. Firstly, FoD has been selected for analysis because all its constituent projects were explicitly oriented towards anticipatory practices at

the intersection of innovation, policy, and society. Secondly, FoD provides a case for directly addressing our guiding research question as it organized policy advice at the nascent, programmatic stages of policy initiation for "Horizon Europe", the Ninth European Framework Programme for Research and Technological Development (FP9). In this regard, FoD provided the opportunity to study processes that were designed to provide support to the mission boards responsible for defining and operationalizing the EC's five innovation missions. Thirdly, FoD evolved around a variety of different methods and approaches, thereby representing a diverse range of anticipatory practices.

The research for this chapter was conducted in 2023 and 2024. At the outset of the research, grey literature and internal documents produced during the course of FoD were subjected to analysis following the approach of a practice-oriented document analysis (Asdal & Reinertsen, 2022). By understanding documents as the sites of practices as well as the means by which practices travel (ibid.), this method helps to bridge ethnographical ways of doing research with text-focused approaches common in sociology of knowledge or policy analysis.

This analysis informed the development of a semi-structured questionnaire, which the principal author utilized to conduct seven interviews with both consortium members and EC officials who requested and managed the projects (see Table 13 in annex). The questionnaire design was inspired by existing practice-theoretical interview approaches (Shove et al., 2012, e.g.; Spaargaren et al., 2016) and aimed to elicit personal reflections on the meanings, materials, competences and experiences connected to practicing foresight. Instead of inquiring about the methods utilized, which would have increased the likelihood of producing rationalized accounts of formal foresight designs, the interviewer instead focused on the personal work routines and typical steps involved in a project's lifecycle. The interview transcripts were analyzed following a flexible coding approach (Deterding & Waters, 2021). All material was coded in the qualitative data analysis software MaxQDA. At the start of the analysis, codes were deduced from the focal points of the conceptual framing. By tacking back and forth between conceptual considerations and empirical material, new codes were inductively produced to further classify and condense statements.

Furthermore, a focus group was convened, during which six members of the FoD consortium offered detailed feedback on the preliminary findings from the interview analysis. Originally this research design followed the idea of a validation of qualitative data through triangulation. However, the analysis of the recorded and transcribed focus group session revealed that the setting constituted an alternative site for

making sense of the practices in FoD, rather than merely validating hypotheses derived from the interviews (Flick, 1992, 2009). Therefore, the collective exercise provided an additional site for observing how the activities that unfolded throughout FoD are reconstructed in a group context and how the meanings attributed to anticipatory practices are socially constructed therein.

Instead of positioning us as distant observers, the practice approach demanded for moments of direct involvement with the object of research. While the primary author was not directly involved in the FoD projects, all co-authors of this chapter were active consortium members. While most of the material represents narratives of practices and not direct observations of practices, this limitation is partly compensated by the co-authors contribution of tacit practical understanding, which is considered necessary to discern anticipatory practices (Wenzel et al., 2020, p. 1451). Following a retrospective autoethnography approach (Ellis & Adams, 2014), they provided insights into specific projects as well as the formation and workings of FoD, which were incorporated into this chapter.

Case study: Reconstructing Foresight on Demand

In this section, we zoom-in on practices that evolved throughout FoD's duration. Therefore, we reconstruct the concrete doings that were practiced, the reflexive learning process that was implemented and the chains of action that superseded the delineated contract context. Before zooming-in on the anticipatory practices, however, we take a step back and reconstruct a cascade of network-building activities that led to the institutional consolidation of foresight within the EC. For this purpose, the following section provides a brief genealogy of FoD.

A brief genealogy of foresight in the European Commission's Innovation Policy

Foresight has a long history in the context of European STI policy, dating back to the year 1979 when the FAST Programme (Forecasting and Assessment in Science and Technology) was launched, aiming to explore new avenues for research policy (Burgelman et al., 2014). In the 1980s and early 1990s, foresight was further strengthened by the creation of several networks, institutes and units, most notably the Forward Studies Unit, the Institute for Prospective Technological Studies and the European Parliament's Science and Technology Options Assessment. With the growth of these scientific advisory bodies and the establishment of the inter-institutional foresight network ESPAS (European Strategy and Policy Analysis System) by the turn

of the millennium, foresight practices began to institutionalize across European public administration. This development was further amplified through various initiatives involving public and private stakeholders that called for greater integration of foresight into policy making and succeeded in making it a central feature of the EC's Better Regulation strategy (Commission Communication, 2021).

This institutional consolidation process, however, did not prevent the EU being taken by surprise when unexpected developments like the financial crisis in 2008/2009 or Arab spring in 2011/2012. The experience of crisis, surprises and uncertainty has increased the perceived need and legitimacy for foresight on the part of many officials and political leaders. This led to the formation of the European Forum on Forward-Looking Activities (EFFLA), which operated from 2011 to 2014. Its mandate was to i) aggregate the results of outstanding forward-looking activities, ii) offer advice on how to use these results for the early identification/understanding of existing/emerging 'grand societal challenges', and iii) provide advice and evidence on how these trends could affect European R&I systems and linking the changes to political processes. Later, EFFLA was merged with other high-level expert groups into the Research, Innovation and Science Policy Experts High Level Group (RISE), which – with some modifications in name and mandate - continues to exist until today. As a spin-off from RISE, the Strategic Foresight for R&I Policy in Horizon 2020 expert group was created in 2015, paving the way for the launch of FoD.

Foresight for the Framework Programme

The European Framework Programme for Research and Technological Development (FP) mobilizes billions of Euros, funds thousands of projects, and encourages tens of thousands of research proposals from diverse consortia each year. Policymakers face the challenge of defining forward-looking, evidence-based, and legitimate strategic priorities for the FP. To assist in this, foresight expert groups were convened to provide recommendations. These included: integrating foresight into FP processes before setting priorities and policies; establishing a rapid-response mechanism to address significant future developments in a timely manner; engaging citizens and stakeholders in co-designing projects for better governance; and creating an EU-wide think tank for foresight to provide strategic intelligence and foster community-building (European Commission, 2017, p. 8).

These recommendations led to some very concrete actions. First of all, a foresight study was launched to help develop the new FP. The so-called BOHEMIA project, along with the Horizon 2020 Interim Evaluation and FP funding impact modeling, contributed to the influential "Lamy Group," which developed recommendations for

EU research and innovation. Additionally, the EC's Strategic Foresight Network, led by Commissioner Šefčovič, the first dedicated foresight Commissioner, prepared the annual Strategic Foresight Report. Furthermore, the "Foresight on Demand" framework contract was created to implement the EC's "Rapid Response" foresight mechanism.

Institutionalization of foresight practices

What can we learn from this story of consecutive expert group and network formation? We argue that this genealogy presents a case for the institutionalization of foresight (see also Chapter 6). It is of interest from a practice-theoretical perspective on anticipatory practices because it shows how the multi-dimensional process of institutionalization (Scott, 2014) shapes the formation of working practices and routines in the context of innovation policymaking. Concretely, we can discern that foresight entered EC working practices through: numerous expert groups, networks and dedicated units (organizational dimension); the Better Regulation strategy and annual Strategic Foresight Report (regulative dimension); community building and a Commissioner for foresight (normative dimension); benchmarks and best practice examples (cognitive-cultural dimension).

Moreover, the genealogy illustrates how the process of institutionalization can occur concurrently with a specialization of a set of practices. It is essential to recognize that while officials may have always employed anticipatory practices to prepare STI policy, institutionalization has resulted in a discernible set of formalized activities. In the following, we will describe how these formalized foresight practices unfold throughout our case study, how they shape material arrangements and how they relate to other anticipatory practices such as assumptions that underpin strategic policy documents.

Foresight on Demand

FoD officially started in 2019, after a call for tender issued in 2018. The framework contract intended to provide foresight support for different policy domains at the European level. Interviewed EC officials emphasize its significance for "Horizon Europe", the Ninth Framework Programme for Research and Innovation (FP9). While, according to one interviewee from the EC, the practice of negotiating the FP varies from Commission to Commission and is determined by the political exigencies of the present, foresight enjoys a high level of legitimacy "because innovation policy is about the future, and therefore you have to think about the future" [I1]. The formulation and implementation of FP9 was characterized by the EC's adoption of a mission-oriented approach, which aims to align research and innovation with longer term policy

needs and societal challenges. As mentioned above, a foresight project informed the political processes in the "strategic arena" (Janssen et al., 2023) for defining areas and issues which missions had to address. The detailed definition of specific topics for each mission and the operationalization of how and when mission activities should unfold was carried out in the "programmatic arena" by expert groups in so-called mission boards (Janssen et al., 2023). Experts were invited to join the mission boards. Each board shapes and supervises a specific mission.

This process was further accompanied by foresight activities and online citizen engagement. FoD organized these activities and aimed "… to support the reflections of the corresponding Mission Board by providing future – oriented inputs on challenges and options" (e.g. European Commission, 2021b, p. 5). Arguably FoD had the function to work towards the co-creation of a shared vision of future developments within the mission boards (Janssen et al., 2023). But how does such a support look in practice? To glimpse into the anticipatory practices that evolved in FoD, we condensed material from interviews, focus groups and retrospective auto-ethnography.

Doing foresight in changing material contexts

In order to explore which concrete practices, materials and competences are considered important by foresight practitioners and how they ascribe meaning to them, we began the interviews by asking them to imagine preparing a colleague to take on their role in the day-to-day operations. What do they do, when they do foresight? The majority of practitioners highlight practices connected to the sequences of the FoD project life-cycles, which include the call, expression of interest, consortium management, proposal writing, scoping meetings with clients, implementation, adaptations to work plans, report writing, communication, and the bringing to a close of projects. Besides the description of very routinized working practices, they recall experimenting with known approaches to fit new contexts amidst the COVID-19 pandemic. As our discussants [FG] repeatedly emphasized, the material dimension of their work drastically changed due to the absence of physical presence. As it happened in many other contexts, the FoD team and their clients from the EC had to rapidly adapt virtual ways of collaboration.

The changing material contexts precipitated experimentation with diverse soft- and hardware, while the practices themselves remained largely unaltered: The strategic conversations in scenario workshops became strategic conversations via online conferencing. Flip charts and sticky notes became frames and notes on virtual boards. Public engagement became online consultations. Rather than leading to the emergence of wholly new sets of practices, the virtual spaces were used to simulate

exactly the same materials used in physical meetings. In sum, all these activities, whether on- or offline, are directed towards creating discursive spaces that allow for structured, strategic conversations to unfold.

Mobilizing knowledge and actors

Foresight practitioners spend a significant portion of their work identifying and activating experts and stakeholders. Over the course of five years of work within FoD, numerous groups were set up to explore issues such as urban mobility, futures of consumer behavior and ramifications of Covid-19.

This practice involves identifying and categorizing vast and highly specialized fields of knowledge production as well as different interest groups via desk research. The mobilization of experts and stakeholders in the context of Delphi surveys, stakeholder dialogues or scenario workshops is considered a crucial practice for foresight [FG]. Interviewees emphasize that behind the participatory, deliberative and inclusive rhetoric of foresight methods often lies a set of laborious, messy and small tasks that facilitate this mobilization [I3, I5, I6, FG]. Internal documents support this observation and provide insights into the challenges of defining criteria, mapping stakeholders and developing mobilization strategies. Therefore, practitioners report to employ different databases, bibliometric tools and search engines [FG].

Consequently, the practice of foresight is framed as a communicative and group-building effort that amounts to "translating science" for policymaking [I3] and "bringing different disciplines and fields in conversation with another" [I5]. That is, foresight interlinks and synchronizes otherwise disparate bodies of knowledge.

Furthermore, our observations suggest that these practices bring about the staging of expertise. By being invited to contribute their expertise to forward-looking policy advice for shaping the future of European innovation policy, invited researchers and stakeholders may see an opportunity to accumulate symbolic capital. Becoming an advisor to a leading European foresight project can be seen as a career advantage. This invitation is also in competition with other, more or less prestigious conferences, expert groups or networks vying for the attention and engagement of leading experts and stakeholders [FG].

However, foresight would not be foresight, if it only relied on interactions with incumbent stakeholders and currently leading experts. "First, we search for renowned experts on overall relevant topics… the state-of-the-art. Then, we use horizon scanning to detect emerging issues and try to find scientists or key users who are currently

more or less ignored" [I7]. This interviewee hints at the anticipatory practice of using bibliometric analyses based on scientific research databases, or other data sources such as policy repositories, to compare the evolution and dynamic alignment of fields in comparison over time. Thereby, foresight practitioners pay attention to citations, occurrence of keywords, patents or (de-)coupling of fields. This practice produces knowledge on present niche dynamics that potentially shape future developments. Our observations go even a step further. They show that foresight practitioners frame and mobilize certain groups as "antennas" and "experts of tomorrow" who plausibly carry knowledge concerning future technological, environmental, economic, political or social developments.

In this regard, FoD was also commissioned to help bring about interactions with society. Based on the development and staging of short films, framed as "speculative design artefacts", foresight presents itself as a creative practice that seeks to engage citizens in reflecting socio-technical futures. According to the website the objective of this public outreach is to initiate critical discussions about socio-technical scenarios and policy reflections (www.futuresgarden.eu/, last access March 2025).

Exchanging expectations in mission boards

FoD members were not only mobilizing knowledge and producing groups. Foresight practices were also sought to support the existing mission boards. According to the interviews, these first mission boards lacked clearly defined objectives for their work, and foresight projects were requested to help "create an emergent definition of what the board should focus on" [I1]. This demand was addressed through different iterative processes in which the FoD team encouraged members of each mission board to gather and discuss drivers, trends and weak signals as well as potential disruptions or incremental changes for their specific area. For the members of the mission boards, this meant to engage with anticipatory practices of making, justifying and exchanging future expectations through structured processes. According to our observations, three methods are in particular relevant in this regard.

Conducting Delphi surveys allowed foresight practitioners to survey, collect and analyze divergent and convergent expectations. One example in which we could observe this practice was the FoD project Science, Technology and Innovation for Ecosystem Performance. Here, the foresight practitioners conducted a two-round Dynamic Argumentative Delphi survey reaching out to 130,000 experts to assess how specific STI trajectories can accelerate or harm sustainability transitions until 2050 (European Commission, 2023). In the first round, 1,637 experts assessed and refined hundreds of descriptions of specific STI directions and their expected effect

on ecosystem health. In the second round, 638 respondents further consolidated and refined the list. This method does not only serve the gathering of experts' expectations concerning specific future developments, but also facilitates the exchange and potential convergence of expectations by providing round-based feedback of other participants' answers to experts. Like this, statements can be adjusted and ranked, leading to a convergence of individual expectations.

The scenario method, in contrast, facilitates the narration of different pathways of socio-technical change. The "Scenarios for Europe in the post Covid-19 World" (European Commission, 2022) conducted within FoD provide an illustration of this fanning out of alternative pathways. Five scenarios were developed to depict different pathways in terms of economic recovery and member state collaboration within the EU. This process "…is not very conflictual because our methods ensure that different perspectives can be integrated in different scenarios" as a foresight practitioner explains [I7]. Accordingly, scenarios do not need to practice consensus. Through scenarios, different expectations and causal assumptions find their way into different articulations of the future and can be portrayed as alternative futures.

In contrast to scenarios, the visions that emerged from foresight activities in several of the mission boards absorbed potential conflict by systematically articulating a future that was sufficiently flexible for interpretation to be considered as desirable by different actors. Thereby, visions establish a shared normative narrative for discussing goal-oriented action [I3, I6, I7]. In this regard, the cities mission for example states: "Lack of integration means that decisions on e.g. new transport, ICT, energy, real estate developments are taken without concertation and with impacts that will affect cities for decades to come. That is why it is essential to share a vision with major stakeholders, investors and especially citizens" (European Commission, 2021a, p. 32).

There are no true or false articulations of the future. Thus, divergent assumptions, expectations and narratives can co-exist in the practice of foresight. Practitioners emphasize that anticipatory practices and their products serve different functions within policy-oriented foresight processes [FG]. These functions and rationales are, however, not always clear to participants of foresight processes. Reportedly, not all board members embraced the results and some of the experts were even reluctant to actively engage with the foresight activities [I3, I6, FG]. This necessitated explaining the rationale for integrating foresight.

Accordingly, many FoD projects started with foresight learning activities for clients, which helped to showcase how to make use of foresight, scope objectives and expectations [I3, I4, I5, I6]. Despite these scoping activities and the supposedly clearly defined policy demands in calls, goals reportedly extended, and rationales of many projects changed multiple times [FG]. On the one hand, FoD had to follow the meandering of policy debates and demands. This flexibility came at the price of frequent changes. On the other hand, the buy-in of EC officials had to be secured. An interviewee from the EC notes that in internal meetings with colleagues, skepticism often led to dynamically readjusting policy demands [I2]. These changes were seen as necessary by the interviewee to preempt critique of other EC officials that were considered central for disseminating results. Explaining and scoping are seen univocally as essential practices of foresight processes.

Not all team members practice explaining and scoping of foresight equally. While foresight practitioners acknowledge that there is no unified definition of foresight [FG], the available evidence suggests that they tend to rely on a small number of experienced seniors with long experience to take over the task of explaining what foresight is and how it can be used to address a specific policy demand. The assertion that "Foresight would not exist in the Commission without this person" [I3] illustrates the strong and personalized identification with foresight advocates. The work of these individuals aims to leverage foresight for supporting and reflecting policymaking.

"I am here to bring you five seconds of doubt" Undoing assumptions and expectations of Horizon Europe

According to the interviewed EC officials, policy practices shaping STI policy are pervaded by implicit anticipatory assumptions and future expectations [I1, I2]. Consequently, they repeatedly stressed the importance of working on the "hidden assumptions" underpinning existing policy documents and practices. According to interviews with two officials, one of the main goals of policy-oriented foresight should be to provide a space for self-critical assessments and reflexive learning in regard to the ways the future is imagined and planned on [I1, I2]. One of the policy officers brings it to the point by introducing foresight like this to colleagues: "I am here to bring you five seconds of doubt" [I1]. Foresight practitioners echo this need and view reflexivity as a central tenet for the practice of foresight [FG]. They exemplify this reflexivity by referring to scholarly notions such as "deconstructing futures" (Inayatullah, 1990), "challenging anticipatory assumptions" (Miller, 2007, 2018) and "counteracting biases" (Schirrmeister et al., 2020; van Woensel, 2020).

The Framework Programme, Horizon Europe, is regarded by both foresight practitioners and EC officials as the most crucial document requiring reflection [I1, I2, FG]. Given that the FP mobilizes multiple billion Euros, funds thousands of projects and encourages tens of thousands of research proposals by myriads of consortia each year, it can be viewed as a practice performative document which, first, mobilizes and sets collective expectations (e.g. in mission boards) and second, becomes performative in that it coordinates and directs research and innovation. The associated calls are heavily scrutinised by countless research and innovation teams from all-over Europe and associated countries. Researchers and innovators from practically all domains seek guidance on securing fundings for their projects. They read and re-read, interpret, struggle with and modify these texts and translate them into work packages, tasks, timetables and budgets until selected few are ultimately embedded into research activities and into material configurations from experiments in material-science laboratories to social science questionnaires.

In the autumn of 2021, a request for services was issued to the consortium, requesting to "identify and list assumptions and expectations about the future in the documents of the Horizon Europe Work Programme 2021-2022". To fulfil the request, the FoD team screened all related documents via the data analysis software MaxQDA. Five researchers analyzed a total of 2890 pages and identified the different types of assumptions. Initial diversity in assessments was subject to continuous discussion until the understanding across coders became gradually more aligned. Subsequently, the researchers condensed, interpreted and summarized the coded items which resulted in the identification of 202 different assumptions in the documents. The analysis yielded a differentiated picture of the assumptions underlying the Horizon Europe Work Programme. The foresight practitioners emphasized a striking discrepancy between the optimistic expectations for innovation-driven change and the predominantly threat-based perspective on the global context. They concluded that the overarching narrative appears to be one of a heroic struggle of European innovation that will ultimately prevail "against all odds" (Warnke et al., 2023).

Subsequent presentations and discussions of these findings with policy officers brought about a form of reflexive learning regarding the potential performativity of assumptions and expectations in strategic documents.

Chains of action

Did the doings of foresight and undoings of assumptions, then ultimately connect to chains of action that superseded the delineated project contexts? Our research shows how foresight interacts with other anticipatory practices, especially modeling. While

the foresight practitioners emphasize the distinctions between their work and those of quantitative modelers [FG], we find multiple instances where results from socio-economic or environmental modeling are integrated in foresight reports. For many discussants it remains an open question how results from mathematical models or even the very practice of modeling can be meaningfully integrated in the working practices of foresight. Some of our interlocutors even remember conflicts resulting from interactions with modelers who apparently have a "different conception of future" [I6, FG]. This goes beyond an epistemic clash of different anticipatory heuristics. From a practice perspective the challenge becomes clear: There are barely any shared working practices, infrastructures or devices that would facilitate interactions between modeling and deliberative foresight practices.

In addition to interactions with other anticipatory practices, questions regarding the 'impact' of the projects conducted throughout FoD, loom over many of the discussions with practitioners and EC officials. While the foresight practitioners highlight references to FoD in other strategic documents [I3, I4, I5], EC officials report that they often had to negotiate the use of foresight results [I1, I2]. According to the latter, foresight was wanted but it was often unclear how to make sense of and integrate it further: "How can we integrate these weak signals into a report? That was not straight away obvious to everyone in the expert group" [I2]. Although the foresight processes did not directly result in the formulation and operationalization of goals and actions of Horizon Europe, FoD arguably shaped the programme by enabling interactions between disparate bodies of knowledge and different institutional contexts. What foresight practitioners hope to have achieved is to provide a space for "plural perspectives", reflections and possibly a "shift in mindset" for the involved experts, policymakers and citizens [FG].

Streamlining policy processes

Our investigation into the operationalization of FoD as a "rapid response mechanism" for policymaking clearly linked to the strategic timing of organizational action. When asked about the meaning, purpose and practical implementation of a rapid response, professionals involved with FoD hint towards the temporality of practices. Firstly, the rapid response mechanism concretely means to react quickly, i.e. to respond to calls and develop proposals for the Commission within two weeks of time [I4]. As a result, the FoD management had only a few days to match competencies from the partners to establish a dedicated project team and define the roles and responsibilities [I4]. Comparable tenders that organize public procurement for policy advice typically require three or more months from the publication of the call to the submission of a proposal, which is followed by an often-lengthy review process, which in the case of

FoD, as a framework contract, could also be shortened. Many of our discussants stress the importance of "quick reactions" amidst events and crises, such as the 2008 financial crisis or the COVID-19 pandemic, that have come to the fore in the past decades and have not only changed political priorities, but also the timing of workplans [I1, I2, I4]. The question for innovation policy is then not only concerned with setting strategic priorities and directions but also with responding to dynamic temporal demands by, for instance, accelerating consultations or policy initiation through FoD support, which apparently played an important role for many FoD projects amidst the COVID-19 pandemic [FG].

Secondly, the central notion of rapid response manifests in knowledge mobilizing practices that aim to synchronize the pace of policymaking with the pace of scientific knowledge production. It is reported that EC officials require access to specific bodies of knowledge in a more expedient manner than the typical five-plus years between the formulation of calls for Horizon projects and the publication of reviewed research results [I2]. They emphasize that the different fields needed for developing innovation policy—society, politics, administration, science, technology and innovation—all move at different paces [I1, I2, I4]. In order to connect the different chains of action from the different fields with one another, it is needed to align different temporal regimes. An interviewee concludes that the goal is to be able to produce policy and legislation efficiently, by "streamlining" consultation processes. This may include participatory or creative practices to engage with different publics such as through the speculative films described above, but also align expert advice and stakeholder consultations to arrive in time for specific moments of opportunity, where decisions are made (e.g. preparation of the 2nd Strategic Plan of Horizon Europe, specification of the five missions, development of decarbonisation roadmap). The official adds: "The effort to make foresight useful would be by supporting the [political] exigency of moving quickly" [I1].

Discussion: Synchronizing for the policy arena

Our case study demonstrates that foresight practices involve numerous sets of laborious doings. But there is much more going on. Doing foresight includes networking, explaining, mobilizing, experimenting, reflecting and streamlining. The successful adoption of foresight as anticipatory practice depends also on its carriers. As research on "policy entrepreneurship" (Edler & James, 2015) and "anticipatory boundary work" (van der Steen & van Twist, 2013) has shown, the forging of new kinds of interaction in policymaking depend on motivation, authority and leadership of engaged civil servants.

A fundamental aspect of foresight practices is to establish the conditions under which they can flourish. The case study shows that the conditions for policy-oriented foresight presuppose and are shaped by a sufficient institutionalization as well as material conditions that enable practices to unfold. Concretely, it shows how a network of people and artefacts, encompassing lists and boards, expert groups, studies, and strategic documents, serve as the material backdrop and enabler for foresight in the European Commission.

The presented results indicate that foresight practices represent a specific subset of integrated and formalized anticipatory practices exercised in policymaking. As a set of different practices, such as surveys, expert workshops, and stakeholder dialogues, foresight practices bind people and knowledge in a discursive space to imagine, explore, and explicate dominant and alternative innovation directions, strategic goals and their possible attainment. The future-oriented framing activates experts, stakeholders, policymakers and citizens. Current research that provides a glimpse "behind the scenes" of innovation policymaking has already emphasized the need of inclusive and activating framings to create such a space: "In the agenda-setting phase this often requires actors to engage in activities that frame issues or problems in a way that new groups become engaged or concerned" (Normann et al., 2024, p. 3).

Within this space, expectation dynamics can be tested in different actor constellations and social resources can be mobilized to structure the so-called "policy arena", that is a conceptual metaphor describing the contestation and negotiation between actors during the process of agenda and priority setting (Janssen et al., 2023; Schoen et al., 2011). Nevertheless, the creation of such a space and the structuring of a policy arena are inherently presuppositional. Considering the considerable social stratification, specialization of knowledge, functional differentiation and varying temporal demands of disparate socio-epistemic and institutional contexts, the process risks inconsistencies and an overburdening of complexity.

Our observations indicate that foresight practices can circumvent this problem. We propose the concept of synchronization, as an outcome of our research, to explain how knowledge, collective expectations and temporal demands in foresight processes can be aligned along three dimensions.

- Firstly, synchronization means the harmonization of data and knowledge between different entities, for instance, in the case of synching interconnected devices. Foresight practices can help to synchronize different bodies of knowledge. Once actors are motivated and brought together, foresight practices organize and

stage the social performance of knowledge as well as the articulation of interest in expert groups, mission boards and stakeholder dialogues laying the epistemic foundation for policy-oriented innovation direction debates.

- Secondly, synchronization means the rhythmization of collective expectations, for instance, when different future assumptions are made explicit and coordinated. Foresight practices can help to synchronize expectations at the intersection between society, policy and innovation. The studied foresight practices facilitate exchange and convergence of expectations and lead to the articulation of alternative futures and shared visions. Thereby, foresight practices draw in an eclectic collection of trends, projections, surveyed expectations and modeling. Interestingly, they do this without leading to conflict. Rather than confronting different views and interest concerning the shaping of policy directions for socio-technical change, they are either articulated as alternative pathways (scenarios) or supposedly desirable images of the future with a high degree of interpretive flexibility (visions). Furthermore, we have shown how foresight practices assess and reflect the anticipatory assumptions and collective expectations inscribed in strategic documents.
- Thirdly, synchronization means the production of simultaneity, for instance, when timekeepers produce a 'universal' temporal order that extends beyond experienced time. Foresight practices can help to synchronize temporal orders. In the case of FoD, foresight provided "rapid responses" which allowed synchronization of different paces and internal temporal demands, primarily between science and policymaking. In addition, foresight practices can help to stress-test temporal orders by speculating on the emergence of new external temporal demands. By enabling organizations to prepare responses to hypothetical events or developments before their factual occurrence, foresight practices allow for strategic preparation, acceleration, or delay of responses to dynamic temporal demands.

While this conceptualization of synchronization emerged directly from the case study, it resonates with a long thread of sociological theorizing that scrutinizes how time and social order interact. This line of research has produced similar and relevant findings, also for this chapter, by, for example, examining the social synchronizing of media (Jordheim & Ytreberg, 2021), "Eigenzeit" and "temporal autonomy" in organizations (Blagoev & Schreyögg, 2024) or "temporal closures" that shape policymaking (Herberg et al., 2024).

For our case, we argue that synchronization allows for the initiation, staging and early problematization of missions, programs and strategies coalescing interactions

between society, policy and innovation. Table 6 summarizes the findings of the case study, which presented empirical evidence of such a synchronization (e.g. the exchange of knowledge through scenario processes or Delphi surveys, the reflection of assumptions and expectations in strategic documents, the streamlining of policy consultations). We argue that one result of this synchronization is that it sets the scene for arenas, in which deliberation concerning innovation directionality can take place (Figure 7).

Table 6 Case study findings based on the anticipatory practice approach

Aspects of foresight	**Findings**
Anticipatory practices	Production and management of future-oriented knowledge: • Foresight practices synchronize various fields of knowledge production and interest articulation • Future-oriented framings, participatory and creative practices help to activate groups • Foresight practices facilitate the initiation of policy-oriented debates while containing potential conflict through methods Mobilization of collective expectations and techniques of futuring: • Foresight practices synchronize collective expectations • Scenario work, visioning and undoing of assumptions facilitate exchange and clarification of expectations Strategic timing of organizational actions: • Rapid response synchronizes temporality of different fields • Foresight practices allow for preparing and synchronizing responses to temporal demands
Material arrangements	Infrastructures and material conditions in which foresight takes place: • Creation of infrastructures and setting the scene for arenas • Simulated workshop experience in virtual collaboration In- and description of foresight through documents and artifacts: • Foresight practice legitimized through documents • Strategic documents scrutinized by foresight practices
Historical development	Circulation of foresight: • Expert groups, networks and regulations establish legitimacy and develop foresight-policy interactions Adoption and non-adoption of specific practices: • Formalization and institutionalization of foresight practices leads to their adoption as working practices • Integration between foresight and modelling restricted due to lack of common practice

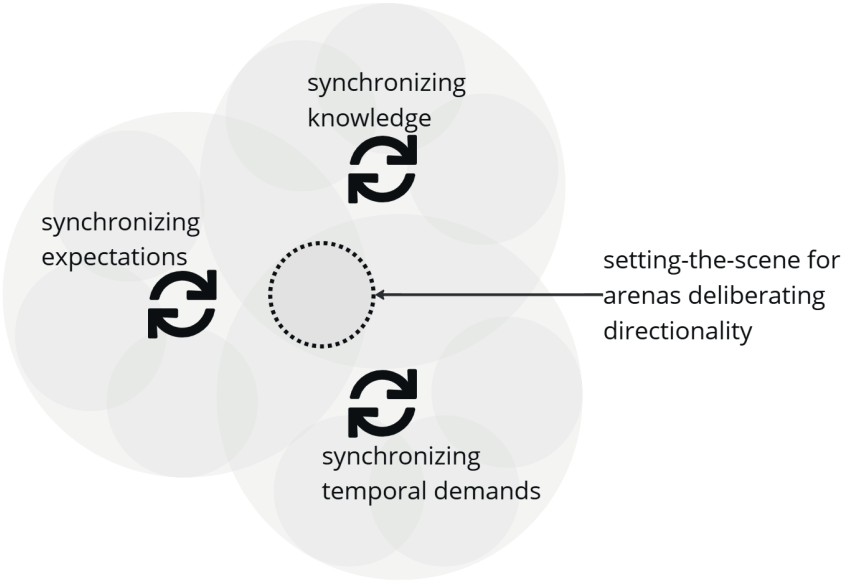

Figure 7 Foresight practices aiming to synchronize knowledge, expectations and temporal demands at the intersection between policy, innovation and society

However, the argument of synchronizing effects as a result of foresight should not be overstretched. We want to emphasize that our findings do not imply that knowledge, expectations and temporal demands become the same for different actors. Synchronizing merely means the chance of exchange between highly differentiated social fields. We thus argue that engaging actors in foresight provides them with the opportunity to exchange across disparate fields thereby grasping the plurality of directions and pathways for socio-technical change (cf. Stirling, 2024). This effect is fragile and easily undermined by prevalent working practices, vested interests, political maneuvering or lobbying, which all exercise a strong influence on processes of agenda and priority setting in policymaking.

Conclusion

Asking how groups and organizations implement anticipatory practices, specialize, and institutionalize them, provides an explanandum for futures and foresight research that, we argue, can contribute important facets to our understanding of how futures are produced and become performative for processes of agenda and priority

setting in policymaking. In view of the burgeoning interest among academics and policymakers regarding the directionality of mission-oriented innovation policy, the initiation of debates on innovation directions is becoming increasingly important.

The case study of "Foresight on Demand", a large foresight contracting scheme for the European Commission, has demonstrated that foresight becomes performative through its practices of knowledge management, expectation exchange, policy reflection and streamlining between different institutional contexts. Findings from the case study indicate that the structured, participatory and creative practices that unfolded through FoD helped to streamline policy consultation (e.g. in the mission boards), reflect assumptions about policy impacts (e.g. with regard to Horizon Europe) and develop collective future-oriented strategies (e.g. on industrial decarbonization). In this regard, our research emphasized also the role of policy entrepreneurs. Although some of the foresight processes may initially be met with reluctance, the participatory and future-oriented framing put forth by foresight has been demonstrated to be an effective approach for engaging and mobilizing different actors. Who does not want to co-create our common future?

In response to our research question, we conclude that foresight initiates discussions concerning the directionality of innovation policy by synchronizing actors' knowledge, expectations and temporal demands at the intersection between innovation, policy and society. Our research unpacks how foresight initiates debates concerning the directions and pathways of socio-technical change. Foresight practices have the potential to shape arenas in which deliberations on future innovation policy directions can take place, in spite of highly specialized knowledge, divergent interests and functional differentiation of the involved actors and institutions. We propose to understand these actions as setting-the-scene for policy arenas.

Furthermore, our case study contributes to the literature on foresight by emphasizing the situated practices that constitute it. In drawing upon the tenets of practice theory, and by integrating practice-oriented research from the fields of STS, innovation studies, and organization studies with foresight literature, we put forth an anticipatory practices approach for studying foresight during the process of agenda and priority setting. This understanding of foresight complements existing conceptual framings that view foresight as a cognitive or mental capacity. While framings such as futures thinking, futures intelligence, strategic intelligence, futures literacy, or anticipatory behavior overemphasize the intended structural benefits foresight is supposed to enable, they obscure that foresight is first and foremost a

practice of managing, exchanging and translating knowledge, expectations and temporal demands.

What is the benefit of praxeologizing foresight? Understanding foresight from a practice perspective enables research to go beyond the intended capacities and policy functions foresight is expected to meet. Our findings show that foresight can catalyze socio-epistemic and organizational functions. This finding has two significant implications for the practice of foresight: For foresight practitioners, paying attention to how foresight practices succeed or fail to synchronize fields may be understood as an additional function and indicator to monitor and evaluate foresight activities. For policymakers, better understanding and systematically analyzing dynamics of convergence and divergence of knowledge claims, collectively-held expectations and temporal demands in the groups and publics that foresight brings about may also serve to test possible lines of conflict before policies are implemented.

This research represents an attempt to examine foresight as a set of practices that occur within particular institutional settings and material contexts. However, we recognize that this research has only offered limited insights into the doings of anticipatory practices that extend beyond the framing of foresight. A further limitation of the case study is evident in its empirical material. While our involvement enabled direct observation of practices and the acquisition of practical understanding, live documentation remains limited, with the majority of the material comprising narratives that reconstruct practices (e.g. in interviews and focus groups). Future research in this area could benefit from these learnings by examining the relationship between foresight and other policy-oriented practices (e.g. modelling for policy, public engagement or negotiations of expectations at the political level) through triangulation of interviews, focus groups and ethnographic approaches that use video, audio or photography as material to depict practice.

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5. Regioning Mission-Oriented Innovation Policy: The Articulation of Directionality between Federal and Regional Arenas in the German High-Tech Strategy

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Abstract

Mission-oriented innovation policies (MOIP) do not operate in a vacuum. How missions align with innovation actors, infrastructures and discourses in regional contexts is an ongoing discussion. In this chapter, we draw on the case of regional dialogues that aspired to facilitate exchange and learning for the missions of Germany's High-Tech Strategy (HTS). We examine the interactional process of 'regioning' MOIP that draws in diverse publics and concerns, ultimately aiming to create institutional arenas where actors from different levels and scales come together to make sense of missions. More than being explicit objects of innovation policy, regions understood through regioning are an implicit practice of policy. By moving missions between federal and regional arenas, involved actors shape a political space for articulating the directionality of innovation policy.

Keywords: *innovation policy, missions, regions, science and technology studies, arenas*

Introduction

As a policy approach, MOIP sets out to align science, technology and innovation (STI) with societal challenges. Missions aim for clear and verifiable objectives, which are to be reached in a limited timeframe through policy and regulatory measures that foster new forms of collaboration and coordination (Wanzenböck et al., 2020; Janssen et al., 2021; Larrue, 2021). While it is widely acknowledged that a mission needs to be based on a shared vision to allow for setting directions (Weber and Rohracher, 2012), directionality should not be understood as static. Transition management has emphasized that the objectives of transformative missions are subject to openness and adaptation, which can be described as "goal-oriented modulation" (Kemp et al., 2007). Innovation scholarship has conceptualized directionality as procedural (Wanzenböck et al., 2020) and dynamically produced through reflection, learning, anticipation and experimentation (Lindner et al., 2016).

Mazzucato (e.g. 2016) has emphasized that missions are a blend of top-down governance and bottom-up approaches. Innovation policymaking is increasingly oriented towards dispersed spaces of engagement, and particularly policies in Europe aspire to 'grounding' STI in a decentral ecology of locally situated practice. Instead of merely engaging actors from the 'supply side' of innovation, STI policy under the frame of MOIP tries to open up to the once neglected 'demand side' actors (Parks, 2022). Ultimately, MOIPS's legitimacy "… derives from the legitimacy of the established democratic processes and from broad participation of diverse types of actors leading to an inclusive agenda-setting process about missions and challenges" (Boon and Edler, 2018, p. 443). Indeed, lacking problem legitimacy and absence of a (shared) vision in regard to a solution are amongst the causes for directionality failure and disorientation (Wanzenböck et al., 2020). While there seems to be a consensus that participation is a key tool for overcoming divergent views on problems and solutions, only little is yet known empirically about the discursive and political processes underlying the production of convergent views for directionality (Wiarda et al., 2023). Even less is known about the spaces in which they take place.

The puzzle of political space in innovation policy has arguably been addressed by innovation scholars and specifically the Science and Technology Studies (STS) that have not only scrutinized collectively-held imaginaries (Jasanoff and Kim, 2015), but also the sociospatial situatedness of innovation processes, differing in social, cultural, political, economic, and institutional positionality (Jasanoff, 2004, 2015; Pfotenhauer and Jasanoff, 2017; Pfotenhauer et al., 2023). Recent debates have transcended the attention towards local context and stressed, in addition, that innovation regions

are circumscribed, characterized, compared, and differentiated in a process of "isomorphic difference" (Irwin et al., 2021). Practitioners of MOIP aim to portion "… socio-technical transformation into manageable and scalable pieces" (Pfotenhauer et al., 2022, p. 5), thus linking 'local' initiatives with overarching missions to circulate innovation direction debates and enable coordination across scales.

Challenges and solutions present themselves very differently in different places (Uyarra et al., forthcoming). A question that has spurred scholarly interest among geographers and scholars of innovation is whether implementation of missions is supported by existing actors, resources or policies at different scales (Coenen and Morgan, 2019; Bugge et al., 2021; Flanagan et al., 2022). In order to analytically capture how missions develop at different political levels and corresponding spatial scales, researchers have conceptualized a model of contiguous arenas, reaching from a strategy to a programmatic, to an implementation, to a performance arena (Janssen et al., 2023).

This literature stresses that the shaping of directionality in MOIP unfolds in a dynamic process, linking activities from top to bottom through multiple arenas situated at different levels and scales. Despite conceptual discussions about the premises for spaces that allow such a process, a research gap remains in empirically observing how missions reach the multitude of innovation actors in regional spaces of innovation. Our research question thus addresses a three-step process: How are innovation direction debates circulated and what practices are involved in moving missions through arenas, how do actors therein respond and how does this process contribute to the shaping of directionality? To address this research interest and to elaborate the understanding of interactions between the administrative implementation arena and the regionally situated performance arena (ibid.), we empirically examine and define a set of practices, which we refer to as 'regioning'. This concept grounds missions in geographic and political space, providing an analytical perspective on two interlinked processes. First, regioning denotes a set of practices, such as participatory formats, that define, mobilize, and connect regions as a category of mission-oriented innovation policy. Second, these practices shape a political space that links various arenas in a way that responds to overarching expectations, such as federal policy targets, thus facilitating the emergence of cross-regional forms of directionality.

The empirical centerpiece of our investigation is a participation process that entailed a series of regional dialogues, which aspired "to involve society in the further development of the Federal Government's research and innovation strategy…" (BMBF, 2019, p. 56), while simultaneously "dovetailing" federal and state levels cooperatively

(High-Tech Forum, 2021, p. 18). The missions included in the so-called High-Tech Strategy (HTS) provided the backdrop for involvement. The regional dialogues were seen as a source of learning for federal missions.

In the following section, we introduce our theoretical concept and afterwards describe our methods and empirical materials. In section four, we turn to the history of German innovation policy, briefly introducing the main tenets of mission-oriented and place-based policy strategies. This is followed by a description of, first, regioning for societal resonance and, second, regioning for directionality. In section five, we problematize the practices involved in moving missions across arenas by discussing how civil servants at the federal level search for regional counterparts with whom they can align missions and initiate reflexive learning. We conclude with the potentials and tensions that come to the fore when national-level missions connect to regional innovation discourses.

Regioning

Against decades of geographic and sociological research, it is safe to say that any region is fractured in many ways, both internally and externally, and therefore entails an imaginative and discursive component that is co-constituted with physical attributes and institutional structures (Agnew, 1999; Gieryn, 2000; Jasanoff and Kim, 2015; Binz et al., 2020). The quest for a regional innovation culture, which started with economic regionalism in the early 2000s (cf. critical discussion in Lovering, 2001) and still shapes current discourse in European innovation policy, therefore is bound to be a multidimensional process which simultaneously defines the region, the desired innovation processes, and regional innovation cultures (Pfotenhauer et al., 2023). Earlier studies highlighted how practitioners in innovation policy have recently embraced a dynamic view on the interaction of political measures and their territorial objects (Pfotenhauer and Jasanoff, 2017; Coenen and Morgan, 2019). This research, which began in geography and transition studies and later included STS, demonstrated how innovation policy creates a spatial framework where regions act both as contexts and agents of innovation policy (Coenen et al., 2021). In this literature, regions are not merely sites or territories of innovation; they are driving subjects and constituted objects, embedded in a multi-level (Dohse, 2000; Kaiser and Prange, 2004) or even "experimentalist" dynamic (Heidenreich, 2005), and become integral to innovation policy process at the national level (cf. Ebbekink and Lagendijk, 2013; Ibert et al., 2015). This view on regions in innovation policy is reflected in the "open regions" approach, which ties together the institutional and the spatial

scaffolding of innovation frameworks (Schmidt et al., 2018). Additionally, scholarship on MOIP suggests that regions can address grand challenges by concentrating on the most pressing societal issues within their territories (Coenen et al., 2015).

This chapter contributes to the currently evolving research nexus of critical innovation studies, STS and geographies of knowledge. We propose the concept of 'regioning' to capture a dual movement where regions act both as agents and territories of innovation policy. Unlike regionalization or placemaking (Walker, 2024), which emphasize creating places or examining mission effects within regions, regioning focuses on the making of a political space. This space facilitates trans-regional attachments, articulating the multiplicity of societal challenges and the plurality of possible innovation directions. The notion of 'regioning' parallels the concept of "infrastructuring" in STS (Star and Bowker, 2002; Le Dantec and DiSalvo, 2013). Rather than being viewed passively, regions, like infrastructures, actively draw in diverse publics and concerns to establish shared understandings, standards, values, information flows, contact points, and institutional arenas. This process shows that regions are not mere settings or subjects to discursive negotiation; rather, they can be understood as a set of practices of innovation policy that sustains and mutually connects multi-sited settings of public involvement. Unlike infrastructuring, regioning emphasizes the relationship between different scales, which are crucial elements in varying political orders (Kuhlmann, 2001).

Our aim is to pinpoint the practices involved in co-constituting and interweaving these different contexts. Therefore, we zoom in on consultation, participation, or foresight practices that link together to form a political space in which actors, be they federal innovation policymakers or local activists and entrepreneurs, position themselves in reciprocal audience roles while sharing a focus on the directionality of innovation. Regioning thus comes down to a multi-sited communicative practice bound by meanings, materiality, and competences (Shove et al., 2012), where actors from different levels and scales come together.

Whereas regioning is not exclusively reserved for the context of MOIP, it is especially useful as a concept to analyze how (driven by the intention to open-up innovation policymaking) a transversal political space is created to debate missions. Regioning, as the conceptualization of a set of practices that can drive coordination across communities at different scales, contributes an elaborated understanding of the circulation of innovation direction debates to the concept of mission arenas (Janssen et al., 2023). In the process, missions move from the arena of policymaking and implementation, which is (mainly) shaped by civil servants, to the performance

arena that resides in constellations of local innovation actors (e.g. firms, universities, NGOs, start-ups). This process gives increased importance to "civic entrepreneurs" as intermediaries between regional and institutional spaces (Ebbekink and Lagendijk, 2013; Silva et al., 2018). Temporary and spatially scattered moments of contact are used to articulate, confirm, and adjust each other's narratives about the way that regional innovation cultures and their relation to national innovation strategies ought to be governed. In this process, a host of local and national actors iteratively portrays and projects supra-regional ideas on specific places. In turn, specific places are used to somewhat enrich the national innovation strategy. Ultimately, a specific line of policymaking, MOIP, is taking shape, which (present and absent) stakeholders can expect to have a large impact on both national policy and regional innovations.

Methods and materials

This analysis draws on our involvement in a consultation process that brought together actors from science, politics, economy, social movements and other fields of society to discuss German STI governance alongside the HTS in seven regional dialogues. As a pilot, this co-creative process aimed to try out public participation for Germany's mission-oriented High-Tech Strategy. The authors of this chapter played active roles in organization, implementation and follow-up of these dialogues. In this process, we attended, prepared and documented several meetings with federal policy officials, regional partners and facilitation experts who were involved in the regional dialogues of the HTS. Hence, our role as embedded researchers was partly to construct a field for researching the linking between national-level MOIP and regional innovation discourses. The idea of "constructing a field" in order to bound a studied phenomenon follows a long tradition in ethnography and has recently been applied in other fields of research (Karasti and Blomberg, 2018).

From 2020 to 2022, we collected empirical materials including field notes, policy documents, secondary literature and interviews. The starting point of our research consisted of the interpretive text analysis of five selected official HTS documents. Then, we analyzed field notes from all regional dialogues. To contrast what we observed in the group setting with individual accounts (Hollander, 2004), we conducted eight semi-structured interviews with involved persons from both the ministry that commissioned the process as well as the regional teams, elucidating the interplay between federal and regional contexts. Moreover, we encouraged interviewees to reflect upon the process in hindsight to collect different assessments of what was done and said and how it had evolved after the regional dialogues.

Topics discussed in the dialogues covered a broad range of mission interpretations. Regional contexts differed largely, from 'laggard regions' to metropolitan centers of science and innovation. The objective of our research is not to contrast the disparate regional settings and dialogues. Rather than presenting these observations as discrete entities, we integrate them into a single case study in order to elucidate practices that facilitate the movement of missions across different arenas.

The material – interview transcripts, field notes and policy documents – was coded along conditions, practices and consequences (Corbin and Strauss, 2008) of moving missions across arenas. In order to examine observations, interviews and official documents together and relate them to each other, we chose a situational and practice-oriented lens that helped us to focus on how meanings and collective activity emerge in a participatory setting, without overemphasizing the influence of structures that shape situated behavior. The practice-oriented approach further allows us to make sense of both, official documents and situational transcripts from interviews and observations. The situational accounts gathered throughout the dialogues and interviews helped to gain an understanding of the involved actors' agency, their interpretations and practices that often went beyond the official framings the dialogues were based upon.

Case study: A multi-sited political space for articulating directionality of HTS missions

HTS, its genealogy and relation to regional contexts

The logics and strategies of innovation policy in Germany – especially their spatial and social integration – has shifted in recent decades. The idea of embracing societal challenges as a cornerstone for German innovation policy became a widely shared ideal instead of focusing on key technologies. The HTS is one of the main outcomes of this trend towards mission-oriented innovation policy, under which the German government increased its annual R&D spending from 9 billion Euro (2005) to 18.8 billion Euro (2019). The genealogy of MOIP in Germany has strategic, practical, political and spatial aspects that are important to understand the meaning of regional consultation for the emerging regime of innovation policy.

According to Edler and Kuhlmann (2008) the innovation approaches that led to the HTS emerged since the early 2000s in the course of an increasing recognition of globalized competition, a general fragmentation of the German “knowledge system” (research, education and innovation in the federalist context) and a friction between

state institutions: On the one hand, the Federal Ministry of Research and Education (BMBF) and on the other hand the Federal Ministry of Economic Affairs (currently: Economic Affairs and Climate Action). Since 2005, the responsibility for governing large industrial sectors such as energy, space or transportation has been transferred from the BMBF to the Federal Ministry of Economic Affairs, thereby reducing the scope of the BMBF's sectoral policy mandates. During this development, the governments led by chancellor Merkel iteratively developed the High-Tech Strategy with every legislative cycle between 2006 and 2018. The multi-faceted goal was to contribute to the coordination of the federal government and the regions (the Länder are decidedly in the second row here), to establish a streamlined solution to the coordination problem between ministries, and to facilitate a more effective transfer of knowledge to industry. Many policy documents portray this approach as a response to an alleged innovation deficit – among other aspect, the failure to transfer research and development into marketable innovation (BMBF, 2019; EFI, 2021, 2022) (cf. Pfotenhauer et al., 2019). Tax law and other measures were supposed to facilitate venture capital attraction, specifically highlighting emerging markets in complex technology development as the main opportunity for German businesses to compete on a global stage (Weyer and Schneider, 2012). This orientation towards global competition translates into a vague idea of regional powerhouses and inter-regional competition.

National strategies of competitive innovation, however, did not go hand in hand with a directive approach to federal policymaking. The HTS, among other measures, broadly recognized policy proposals that sought to promote technologies not by means of direct promotion and investment. Instead, the rising policy aspiration was to shape environments that integrate economic, legal, social and societal conditions to benefit national innovation dynamics in global lead markets (Meyer-Krahmer, 2005). These societal conditions are, for example, the qualification of employees, the attraction of venture capital, or the acceptance of technologies as well as the instrumental link of innovations with larger problems in health, sustainability or other areas. These aspects naturally take place in regional settings. The idea of accelerating innovation thus highlights the internal workings of regional clusters. These considerations motivated policymakers to increasingly focus on multi-sectoral and multi-scalar innovation strategies. Not only supranational markets, but also local stakeholder consultations came to be seen as main arenas for successful policy.

The emerging field of MOIP highlights a set of values for good policy practice. In the case of the HTS, this meant for its initial version from 2006 focusing on key technologies in so-called fields of technology as well as implementing an inter-

ministerial cluster strategy. In the first iteration from 2010, the "HTS 2020" made a move away from solely focusing on key technologies and embracing societal challenges as a cornerstone for German innovation policy. The challenges appeared in five fields such as climate/energy, health/nutrition or mobility. Despite the revamped version's mentioning of MOIP, no missions were formulated yet. It took another four years (the development of the "HTS 2025" in 2014 and its progress report from 2019) for what can account for a formulation of missions to arise. This more consequential adoption of a MOIP approach led to the development of twelve missions in three fields of action included in the latest version of the HTS. They address a broad range of topics from technology development over health-related topics to sustainability goals and partly embrace (Wittmann et al., 2021) the shift towards transformative innovation policy (Weber and Rohracher, 2012; Schot and Steinmueller, 2018). Given many analysts' impression that the mission-labelling is simply superimposed on rather conventional instruments, there is an on-going debate whether the HTS missions, analytically speaking, deserve the label or whether the more cautious formulation of a mission-oriented strategy is not more appropriate.

This genealogy sets the stage for our research focus as it, first, has undermined considerable parts of the mandate that the BMBF has for innovation policy. Given the relative independence of German federal ministries (Ressortprinzip), the overall federalist structure and the increasing dominance of other ministries, the BMBF can only coordinate efforts to make innovation policy more coherent. Second, contextual and spatially complex factors of global competition, future sustainability and local participation have gained importance in the strategic design of innovation policy. Altogether, the power of federal innovation policy mostly relies on discursive influence while juggling multiple stages and scales of high-stakes policymaking. This shows that the HTS has strong, but relatively obscure focus on regional innovation. We now describe our case study in order to articulate this focus in its practice and political implications.

Regional dialogues: The mobilization of a responsive policy regime?

In 2020, the BMBF, in cooperation with the High-Tech Forum (HTF), a committee made up of actors from science, industry and society that advises the Federal Government in implementing the HTS, initiated a participation process, which sought "to involve society in the further development of the Federal Government's research and innovation strategy, particularly with regard to societal factors and implications." (BMBF, 2019, p. 56). It took place from June to September 2020 in the form of seven regional dialogues. Instead of construing a public representative for the society at large during the process, as if it would have been the case for a citizen

assembly or other socio-demographic forms of stakeholder selection, the design of the process took shape along the lines of regional innovation contexts. The HTF members hosted the dialogues in regions that are accessible for their respective institutional network, and arguably are exemplary for different regional innovation systems in Germany. Specific missions and related topics emerging from the HTF consultations were matched to regions (see table 7). This matching of national missions to regional problems and capacities was presented by members of the High-Tech Forum as a pragmatic decision. The precise approach employed in the decision-making process remains unclear. Some of the involved persons view the outcome as an indication of how a geography of missions is imagined. This is to say that they perceive specific challenges and innovation clusters to be regionally bound, and thus distribute missions accordingly across space.

During preparation of each dialogue, regional teams projected the respective mission onto the regional context. They identified sites, local issues, networks and organizations seemingly relevant for the mission. Next, the commissioned agency together with the regional teams implemented a structured foresight dialogue that aimed to debate innovation directions and deliberately set future targets by imagining and discussing potentially innovative prototypes. During one-day workshops local STI stakeholders (research organizations, businesses or business developers, activists, start-ups and neighborhood initiatives etc.) came together to collectively formulate ("co-create") so-called prototypes that produce impulses for the respective regional context and address the selected mission(s). Subsequently, a more strategic core team of regional stakeholders and the commissioned researchers documented and prioritized results and formulated central messages for further development of the HTS, so-called “key messages”, that were meant to translate feedback from the regions to the federal level. Lastly, actors at the national level, such as members of HTF, BMBF and roundtable of state secretaries, discussed the amalgamated messages.

Table 7 Matching missions and regions

Regional dialogue	Addressed HTS mission(s) (BMBF, 2019)
"Flexible careers in science" Frankfurt	"New sources for new knowledge"
"Sustainable Bremerhaven - Ideas Exchange for the Urban Society of Tomorrow" Bremerhaven	"Create sustainable circular economies" "Substantially reducing plastic pollution of the environment" "Ensure good living and working conditions throughout the country" "Build up a battery cell production in Germany"
"Sustainable urban mobility" Karlsruhe	"Develop safe, networked and clean mobility"
"Responsible research and development in bio-IT for health" Cologne	"Digitally network research and health care" "Combating cancer"
"Participating in change, but how?" Lusatia	"Ensure good living and working conditions throughout the country"
"Artificial Intelligence in agriculture and forestry" Osnabrück	"Put artificial intelligence into practical application"
"Science, open up! Science and society as an engine for innovation" Berlin	"New sources for new knowledge"

In the words of the HTF the rationale of regional dialogues was "to dovetail federal and state levels cooperatively" (High-Tech Forum, 2021, p. 18). Given the limits of a federal ministry's mandate to interact with sub-national innovation contexts, the BMBF formulated the objectives of the process more cautiously framing it as participation to discuss the national strategy (BMBF, 2021, p. 10). It is important to note that the process thus followed a dual objective, namely promoting HTS-inspired innovation activities in chosen regional innovation systems, while simultaneously creating feedback and learning from these regions for federal processes to shape national innovation policy. The underlying motif was both issue convergence and societal inclusion.

It remains to be seen how this motif was enacted: Which practices are used to move missions across arenas and create societal resonance? What issue-related or relational tensions come to the fore when the HTS missions meet with discourses in different regions? How do stakeholders from the sub-national level appropriate federal missions? Do they (re)shape directionality at the federal level and what does the federal level learn from the regional inputs? In the following, we present empirical findings from two years of research that address these questions and illustrate the institutional and interactional practice of regioning MOIP.

Regioning for societal resonance

In the interviews with representatives from BMBF and HTF, it became apparent that the HTS is implicitly driven by a desire to elicit societal resonance. Yet, the regional settings are not only created to initiate local innovations or to gather participatory legitimation, but primarily to inspire the policy strategy for a more robust implementation later on.

Simulating regional publics

The politically most graspable element of regioning is the formation of regional publics. One interviewed civil servant says:

> "We need some form of organization that can serve as a counterpart. This cannot be the citizen in his individual appearance… Civil society is not a counterpart at first. Except as a voter. That brings us to the other topic. And that's why we need some kind of organized structure that we can deal with. These are then the citizens' dialogues or citizens' councils or whatever. But, I don't think there is any pressure from any side to set up something like that; it's more of a pragmatic thing. How else can you do it?" [I1]

Federal policymakers thus highlight the need for a relevant public in order to complement the development of federal strategies of MOIP. The driving idea behind the HTS therefore is the notion of a civil society as a sounding board to be created in the process of consultation so that a responsive line of consultation between policymakers and their publics emerges.

However, the affected public was not pre-defined as a conventional participatory process would suggest. Rather, attachments between local actors, innovation missions and the federal process may eventually inform a stabilized MOIP setting, which necessarily had to include a constitutive public. An intended effect of the regional dialogues therefore was not to intervene in regional innovation processes, nor to gain public legitimacy for concrete decisions or the formulation of innovation missions. Rather, the desired side effect for the HTS is to "enable early and long-term participation (not project based)" [I1] in MOIP by collecting, integrating and broadly representing diverse inputs from several sites and audiences.

As the analysis of material from participant observations during the dialogues and ex-post interviews shows: Instead of a clearly delineated purpose of democratic participation or stakeholder collaboration to foster local innovation clusters, the

dialogues follow a broad, highly decentralized vision of consulting the federal government by means of collecting local knowledge in diverse regional settings. In the process of regioning, the local public of innovation policy is not effectively established, but rather simulated through a set of practices connected to participation, consultation and foresight.

As described in section 4.2, relying heavily on the networks of the HTF members, local actors are first mapped and identified via desk research, interviews and snowballing. These inquiring practices and the performative act of welcoming them as innovation actors in an official HTS workshop form a public that can justifiable represent (a part of) the regional innovation ecosystem. During the workshop, ongoing innovation activities are documented and loosely linked to the chosen federal mission. Through moderated group discussions, virtual and actual post-it writing and presentations, a co-created prototypical innovation to address a local challenge takes shape. As our notes from the regional dialogues indicate, the collective imagination simulates the setting of directions for innovation and prepares the strategic discussions of regional challenges and the formulation of key messages for federal innovation policy.

Alleviating socio-economic rupture

Three exemplary regional dialogues took place in Bremerhaven, an old harbor town near the North Sea, Osnabrück, a central place in rural Lower Saxony, and Lusatia, the former industrial powerhouse of East Germany. In these regions, which are partially and unevenly shaped by socioeconomic hardship and political alienation, the simulation of a responsive innovation regime took shape. The regional actors we interviewed generally welcomed this idea. The local organizer of the Osnabrück dialogue, for example, stresses how particularly peripheral areas can complement federal innovation policy:

> "It's no use telling people in Berlin that I'm doing this and that; they have to have selected projects in the regions. (…) And if you say somewhere in the region: *Here, you can take a look at how an electrolysis unit works and a fuel cell heating system*. I can see that here, too." [I2]

Consultation and science communication, according to this interviewee, promise more legitimacy or even sustainability of novel technologies against the backdrop of global developments. All interviews stress that this rise in legitimacy is direly needed due to past policy failures and declines of the regional economy. In participating in the HTS, they therefore recognize their own hope for including peripheral regions into federal policy. Several interviewees even stress the regional approach as a

corrective to prevailing approaches that see the support of "social infrastructure" as secondary. One exemplary interviewee accordingly regrets the prioritization of a narrow understanding of innovation:

> "But there is a clear political guideline that says: *First of all, the economy and science must create the prerequisites. And only in the second step do we take care of the social infrastructure.* Now, you can think that's good and you can think that's bad. I don't think it's so great, because I believe we have to think about both in parallel. Because what happens if we now need five years just to establish ten years of business and science? The people who are supposed to work there and want to make a difference, they also want to live somewhere, yes." [I4]

In Lusatia, where this respondent is based, the coal phase-out triggers new structural investments and raises memories of the post-socialist as well as industrial decline of the last decades. The idea of cross-regional integration, in this context, also implies a problem statement about the lack of societal cohesion at national level. In Osnabrück, too, the dialogue organizer emphasizes issues of labor and socioeconomic integration. He argues that it is not ideas that are missing, but "if we increase research spending in the direction of the 3.5 % target, we need one hundred eighty, or two hundred thousand more young researchers in our country" [I2]. In this instance, the integration of diverse settings into innovation policy would bring to the fore the shortcomings with regard to enabling conditions such as social cohesion, mobility infrastructure or human capital. One participant in Bremerhaven, where the decline of the wind energy industry arguably represents a reiteration of the decline of the port industry, stresses the loss of jobs and identities as an undermining factor to current innovation policy. Also here, social cohesion and the local labor force are main concerns. The lacking "social infrastructure", and the lacking support thereof in federal innovation policy, particularly challenges the regions that traditionally thrive on conventional agriculture and industry.

One function of the multi-sited dialogue was to facilitate local publics that can serve as a responsive sounding board. Regioning, in the political dimension of addressing and coordinating diverse interests, thus has the purpose of generating the constitutive social relations and political issues, leading to robust attachments to, or even a convergent strategy. The two sections above suggest that regional participants welcomed the idea of a place-based paradigm shift in STI policy due to concerns about its socioeconomic and political-spatial disintegration.

Seeking federal confirmation: "We're not just making something up here"

The local participants perceive the regional dialogues as a sign towards substantive improvements in the responsiveness between regional and federal contexts, and not as a mere pilot or policy experiment. Most interviewees that identify as local stakeholders express the hope that the dialogue is part of a potential trend towards an alternative innovation strategy. This positive vision ties together national and regional contexts, or as a representative from Lusatia has it: "So that you somehow establish a reference again and again, and say: "We're not just making something up here, but this also has a reference" [I4]. The notion of a reference in this context comes down to the quest for political confirmation by linking activities in the region to federal networks. Similarly, another interviewee describes how the regional economic development agency was inspired by European and German mission statements when they developed a funding program called "Social Mission Possible" [I7].

The federal German government sought to establish a counterpart in regional publics, while regional publics welcome the confirmation of their relevance. This aspiration, recognized in other regional innovation policies, consists of scaling down federal missions and grounding them "home" (an expression used to describe similar settings by Irwin et al. 2021). In this aspirational reading of the HTS, which many of our interviews seem to share, the overall mission-oriented strategy does not discriminate against, but rather learns from different place-based settings. This does not only ensure the local acceptance or embeddedness of federal policy, but also facilitates the incorporation of regional concerns into the federal response strategies.

This appeal to proximity and inclusion characterized the nature of the local events. It has motivated participants of the Osnabrück workshop to discuss Artificial Intelligence in the context of multiple demographic and economic frictions. In their view, regional dialogues have the potential to contextualize innovation missions. Another place-based reading of regioning practices entails the articulation of differences and similarities across regions. In Bremerhaven, as our field notes show, this means that it is not enough to frame the city as a "climate city", but to complement the overarching problematic with a site-specific negotiation about the future of its port. Local participants and observers from other regional dialogues applaud this focus on a particular site as an advantage in order to ground the mission-oriented discourse in a distinct locality. Moreover, the dialogues were welcomed by participants as a form of expectation management across scale, so that one could be sure that local activities have federal support, and vice versa.

What came out of the inclusive aspiration of the so-called regional dialogues? In hindsight, our interviewees critically comment on the social aspirations towards scaling and placing federal innovation policy. Throughout the analysis of the empirical material, we encounter statements of puzzled participants who are unsure about the BMBF's intentions and expectations towards the dialogues. Thus, while regional dialogues are visible, transparent and potentially recognized from a federal point of view, there is considerable confusion with regard to the opposite direction of the dialogue. Though representatives of the BMBF followed the regional events by listening in, they purportedly did not engage in them. Irritated by this mere observational presence, interviewees describe the BMBF as an almost invisible interlocutor. "Because, yes, the BMBF actually played no role" [I3].

The workshops reportedly simulated a cross-scale dialogue, but did not establish the communicative reference point that the interviewee hoped for. This highlights an aspect of simulation that concerns the role of local speakers, too: The dialogues created a considerable asymmetry in the way that federal expectations and policies were merely anticipated on the local level, which required an extra effort to discuss and internalize the presupposed counterpart at the federal level. Regional participants somewhat pre-supposed the cross-scalar dialogue and insinuated an inclusive paradigm shift on the federal level. At the same time, the governmental organizers of the process were able to shape and listen to the local events without needing to participate. Thus, the social process of scaling emerges as a linear and asymmetric practice, contradicting the aspirational goal of achieving participatory innovation policy through multi-level dialogue.

Regioning for directionality

Above sections have shown that it is difficult to do both things at once – grounding and scaling innovation policy. Another dimension of the regioning process addresses the directionality of missions. The dialogues were shaped as settings to creatively enrich the innovation missions, while validating their societal acceptability.

In search for scalable issues

Interestingly, none of the nearly 200 people involved in the dialogues openly opposed the directions set out in the strategy's missions. In that sense, the dialogues can be read as a positive confirmation of the HTS indicating convergent views on problems and solutions laid out in the strategy. On closer inspection, the regional events re-shuffled the pairing of problems and solutions across regional and federal settings.

Dialogues cautiously connected researchers and developers of the key technologies listed in the HTS with potential future end-users. Beyond the idea of societal inclusion, the diversity that spanned across neuro science, automotive engineers and local neighborhood initiatives provided a platform to test the scalability of certain issue framings across social audiences. The preparation of regional dialogues in Osnabrück, Karlsruhe and Cologne that had a clear focus on what the HTS frames as the "technological base of innovation" show that regional actors did not necessarily agree with the role that is attributed to specific innovations.

The regional dialogue in Karlsruhe, for example, focused on the topic of sustainable urban mobility. A hybrid event brought together transport policymakers, mobility researchers, engineers and a hyper-loop start-up (online) with local neighborhood initiatives (connected from a living lab in the city's east). Interestingly, participants quickly formulated their very own societal challenges: Participants voiced their critique that motorized private transport takes up urban space at the expense of other quality of life factors, such as public meeting places, green spaces, or the opportunities and uses of other forms of mobility. There was consensus amongst the participants that technologies do not "automatically" lead to a better quality of life or more balanced mobility. During the workshops, they made explicit that autonomous driving does not solve the problem of space-consuming motorized private transport. This illustrates the discrepancy between proposed high-tech solutions and perceived challenges in local neighborhoods.

In need of a receiving end

The participatory process of the HTS aspired to translate and consider problem framings diverging from national missions. A group of selected participants from all seven dialogues developed messages for the continued policymaking process in regards to the HTS. As one of the crosscutting challenges, which includes the communicative aspect, some interviewees speak about “scaling”. For example:

> "I believe that one of the challenges is actually the transfer, i.e. how can the results be transferred to the federal level, scaled up, without drifting too far into the general. Exactly, that's why I found the approach that was chosen in the key messages, to formulate key messages, to additionally underpin them with concrete examples, which in my view made them very handy." [I5]

This interviewee, working in the federal government, highlights that regional impulses potentially translate to federal missions. Generally, the interviewees underline unisono that in their assessment, there has been a successful transfer of ideas, expectations and needs for strategic innovation from the regions to the federal level. As one interviewee puts it: "We were able to place our ideas at the federal level and promote activities in the region" [I6]. This quote illustrates that directionality of innovation entailed in HTS and its missions was not merely projected onto regional contexts, but regional ideas of directionality were also projected onto strategy development at the federal scale. The strategic condensing of points raised in the regional dialogues and their translation in key messages, thus helped to inscribe a sense for regional relevance in the federal process.

The impact of the mutual projection between regional and federal discourses, however, remains ambiguous for the interviewed regional actors. On the one hand, they emphasize that their regional topics could be placed on the federal agenda. On the other, this idea comes with the hope for swift and graspable implementation. However, none of the interviewed regional participants and hosts are aware of any direct impact on the continued policymaking process. Many interviewees critique a perceived opaqueness of the federal processes. The tension between grounding and scaling innovation policy apparently led to disappointment among regional publics.

This may have to do with the fact that the regional dialogues did not exclusively touch upon locally circumscribed issues, but actually highlighted systemic issues and their articulation in local pressures. For example, the discussion of agricultural settings in Lower Saxony raised the issue of "the security of the protein supply and the security of the fat supply" which, according to one interview, comes to the fore in the wake of the Russian attacks and agricultural collapse in Ukraine.

> "So maybe that didn't work out so well either. To make it a bit clearer that a few very mundane, banal things connect with high-tech, which simply boils down to supplying us with sufficient energy in the broadest sense, food and whatever else." [I2]

While the expectation of federal policy makers was that locally raised issues would be local, the dialogues actually pointed to global relations in the wake of recent emergencies (ecological, socioeconomic and geopolitical). This shows how aspects of scaling regional issues misrepresent the way that those issues can be seen as traversing local situations and global developments.

Empirical summary

The scalar dynamics of regioning in the HTS, which we have described in its social and substantive dimension, can be summarized as follows. Both federal and regional respondents welcome the process as a form of mutual recognition and expectation management – ensuring mutual support across different arenas. Federal actors mostly see the regional dialogues as an opportunity for process-oriented learning and possibly as a model to shape a more responsive regime of innovation policy. Moreover, they hope to learn about specific and locally situated challenges of innovation policy. Regional actors, by contrast, are more aspirational and generic. They see a promise of increasing legitimacy or even sustainability of innovation in the HTS. They hope for a genuine recognition of local inputs to ascertain that "they are not making something up here" [I4], thus sharing the idea of cross-scalar resonance that federal respondents emphasized, too. From these perspectives, the different actors all participate in the practice of regioning.

In another sense, regioning is also a practice of fragmentation that can be criticized because it ignores how issues connect across political levels and geographic scales. This becomes clear from the perspective of regionally situated respondents. They are mostly concerned with responsibilities, cultures, social cohesion, local labor force, lacking "social infrastructure", ecological stress and increasing resource shortages (labor, energy, food etc.) that constrain processes of regional innovation. With these issues and aspirations in mind, regional participants anticipated an instrumentally oriented and socially inclusive style of federal policymaking – leading to effective policy solutions, or at least dialogue about R&D projects, economic policy, democratic accountability, spatial evenness, or other criteria of good governance. Those publics expect from the federal government to deliver a sustained, responsive and solution-oriented tackling of issues that cannot be exclusively addressed at either local, federal or even global scale. However, regioning is not a holistic practice in this normative sense. It rather represents an attempt to stimulate learning across arenas, and to instigate a corridor for policy coordination.

Discussion: Movements, publics and learnings with loose ends

Our case study presents the regional dialogues for the High-Tech Strategy (HTS), as initiated by the German federal government in 2020, as a challenge of synchronizing the issues, arenas and publics that constitute mission-oriented innovation policy (MOIP). HTS, in that sense, is part of a trend that, in line with previous models,

anchors innovation in regions, but simultaneously seeks regions as agents to inspire innovation policy from bottom-up (Coenen et al., 2015; Schmidt et al., 2018). Similar to cases in other contexts, the HTS travels (Pfotenhauer and Jasanoff, 2017), is moved, circulated and translated across contexts (Czarniawska and Joerges, 1996; Clarke et al., 2015), while involved groups vie for discursive influence on future policy, eventually shaping both the regional imaginaries of innovation and the directionality of future missions. Previous contributions have highlighted that several so-called arenas create (potential) passages between national and subnational scales and actor constellations (Janssen et al., 2023). In accordance with this perspective, our case study illustrates the multitude of practices that emerge when civil servants seek contact to regionally embedded counterparts for integrating missions, while simultaneously hoping for learnings for the federal level.

A committee is established, meetings are convened and a participation process is organized. The formation of shared understandings, standards, values, information flows, contact points, and arenas to sustain long-term public involvement across diverse locations represents a crucial yet elusive aspect of regioning. It does not result in the effective establishment of regional publics but only temporarily simulates them through regional dialogues.

At this stage, potential subjects of innovation policy in the so-called performance arena are recruited by regioning practices. Identified representatives of regional innovation ecosystems engage in meetings, participate in regional dialogues and formulate key messages for the continued co-shaping of missions. This performance arena, which would otherwise be detached from ideas of cross-scalar mission coordination, probes a geography for missions at the subnational level and helps to circulate innovation direction debates. Nevertheless, regional dialogues do not solely concern regional matters. Actors respond by seeking federal confirmation and open-up learning processes that do not comprehensively feed into the passages of MOIP, as illustrated in figure 8.

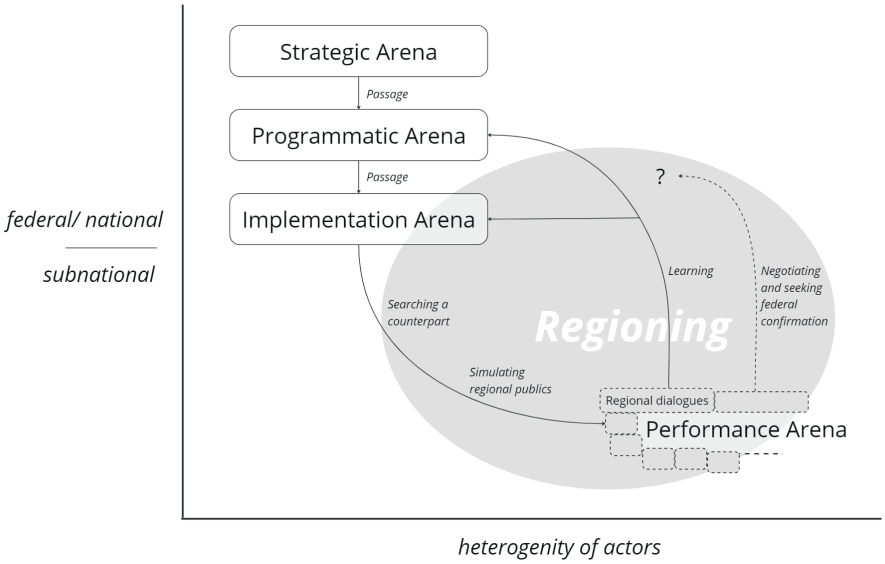

Figure 8 Regioning situated in an adapted arena model (Janssen et al. 2023).

Despite the loose ends in this communicative regime, the legitimacy of the HTS seems unchallenged in the participation process. Departing from theoretical expectations, we would have anticipated processes of contestation and negotiation (Stirling, 2008; Wanzenböck et al., 2020; Janssen et al., 2023). Instead, we observed how, on the epistemic level, actors somewhat self-restricted their knowledge exchange and articulation of interests. Throughout the process, national policymakers involved in preparing and implementing the dialogues provided only broad framings of missions and avoided interfering in the dialogues. From their perspective, the "regional innovation systems" were to speak for themselves. This openness – or rather the lack of connectivity and decision making across the multiple arenas – undermined chances for substantial learning and critique. Thus, the open-ended process did not yield any discernible strategic guidance regarding the prioritization of specific pathways. In lieu of guiding the directionality of innovation through a critical review and renegotiation of missions, the interpretive flexibility of the process resulted in a lack of clear articulation, with references to rather broad, non-binding visions and a proliferation of "new" innovation issues that often fell through the cracks when it came to transferring learning from one arena to another.

Interestingly, the lack of alignment with federal arenas provided regional actors with the opportunity to advance their own problem-and-solution framings, hence pluralizing possible innovation directions for missions. From this point of view,

the HTS process did not only produce loose ends but facilitated the recognition of the "irreducible pluralities of possibility" (Stirling, 2024) associated with the directionality of innovation.

Conclusion

This study has examined the intricate process of "regioning innovation policy," which aims to align temporal and spatial priorities of innovation while accommodating divergent issues and heterogeneous actors. In this sense, our case shows that regions appear not only as explicit objects, but that regioning comes to the fore as an implicit practice of innovation policy that shapes the political space for moving missions across arenas. Our findings provide valuable insights into the threefold research question initially outlined: how missions are moved through arenas, how actors respond, and how this might co-shape directionality.

Missions are moved through arenas by federal policymakers who actively engage with regional counterparts. This interaction initiates the movement of missions, leading to selective yet meaningful moments of societal resonance. By seeking out regional actors, federal policymakers trigger dialogues that facilitate the transfer and adaptation of mission interpretations across different contexts. Regional actors respond to these initiatives with empathy and a sense of promise, recognizing the potential for increased responsiveness. However, the impact of these interactions on social ties across arenas and the management of pressures at both federal and regional levels remains uncertain. The dialogues are often fleeting and experimental, aiming to synchronize innovation policy from the bottom up but not necessarily shaping the directionality of federal innovation policy. In the majority of dialogues, appraisals are collected horizontally in regions, thereby failing to facilitate multi-level dialogue. The fractured communication corridor and the high degree of interpretive flexibility observed in the HTS regional dialogues highlight the challenges and opportunities for coordinating missions across arenas. While these dialogues offer insights into strategic convergence and reflexive learning, they may also lead to loose ends and open cracks, complicating the alignment of federal and regional priorities.

It is an open and pressing question which criteria would govern 'good' regioning. Several measures are recommended. Firstly, regioning should provide concrete framings that consider the geography of missions and the spatially uneven distribution of benefits. This involves reflecting on the positions of involved actors within the problem-solution space. Secondly, the communicative corridor between

implementation and performance arenas needs to be stabilized through repeated dialogues, the involvement of regional ambassadors, and the establishment of sounding boards. Thirdly, policy learning from regional dialogues must be accountable over time and across contexts to ensure sustained progress. While these measures are supportive, they are not sufficient on their own. Achieving a reflexive, responsive, and transversal communication requires transparency in distinguishing where social appraisal ends and political commitment begins. This transparency would facilitate the transfer of ideas between regional sounding boards and federal decision-makers.

For future research, our approach highlights that critical studies of innovation policy can fruitfully study, and connect the mutual shaping of overarching policies and the situated communication, instead of focusing on either one of the two. Moreover, scrutinizing experimentalist consultative practices beyond the frame of participation may do more justice to the way that recent innovation policies seek to integrate various settings and audiences. Certainly, this approach helps to gain an understanding how the experiment to forge a geography of missions is also about the experimental making of a politics of MOIP. Regional (un-)evenness, social integration and strategic convergence of missions are constructed alongside each other.

In conclusion, regioning that pluralizes innovation directions is critical for democratizing mission policies, but it does not necessarily lead to strategic convergence. The pursuit of strategic convergence and reflexive learning requires ongoing efforts to stabilize and enhance the communicative corridors between regional and federal arenas.

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6. Understanding Foresight-Policy Interactions: The Role of Institutionalization

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Abstract

Public administration in governments strives to develop forward-looking capacities. Foresight has come to the fore as a set of practices that is mobilized to counter political myopia. Despite this increasing interest in governmental foresight, research suggests that diverging institutional practices, organizational structures and epistemic cultures between foresight practices and policymaking result in loose coupling. This chapter aims to contribute to understanding these complicated foresight-policy interactions. To this end, we draw on findings from public administration scholarship. The concept of institutionalization is employed to analyze how foresight aligns with working practices and routines in government. Based on an in-depth case study on the institutionalization of foresight practices within the German Federal Government, we demonstrate that scrutinizing the multiple dimensions of institutionalization helps not only to understand where and why loose ends occur but also provides new insights into some of the causes of the lacking impact. The chapter does not aim to provide an easy fix. Instead, we want to sensitize foresight practitioners, reduce both disappointment and overstating regarding the role of foresight in policymaking, and provide a nuanced understanding of foresight practices in government.

Keywords: *foresight, institutionalization, ministerial bureaucracy, foresight-policy interactions, evidence-based policymaking, negative coordination*

Introduction

The ways in which the future is produced and enacted in organizations have pluralized (Wenzel et al., 2020). In response to critiques concerning short-termism and prevailing unidirectional planning paradigms in government (Slaughter, 1996; Boston, 2021; Krznaric, 2021), novel formalized anticipatory practices such as foresight have been adopted in the public administration of governments (Boston, 2016; Choo and Fergnani, 2022). Analysts and scholars have proposed foresight as a means of thinking in alternative futures, dealing with disruptions, uncertainties and risks, and ultimately contributing to safeguarding long-term policy goals (Fuerth and Faber, 2012; Boston, 2016). Notwithstanding widespread experimentation with foresight practices in various governments and public administrations, the question remains how to implement foresight-policy interactions. Several researchers have analyzed foresight-related public sector innovations within the context of the political-administrative system. The term 'governmental foresight' is used to describe the integration of foresight into the working practices of the executive branch of government. In conjunction with a set of recently published benchmarking studies, frameworks and recommendations for governmental foresight (Kimbell and Vesnić-Alujević, 2020; Tõnurist and Hanson, 2020; School of International Futures, 2021; Warnke et al., 2022), the long-standing debate in the futures community about the institutionalization of policy-oriented foresight has been reinvigorated (Solem, 2011; Fuerth and Faber, 2012; Schmidt, 2015; Heo and Seo, 2021; Choo and Fergnani, 2022; van 't Klooster et al., 2024).

A considerable number of accounts in the existing literature present a cautious outlook. In their analysis, Van der Steen and van Twist highlight that despite the extensive body of policy-relevant studies on future developments, anticipatory knowledge remains largely absent in the policymaking process (2013, p. 33). To explain this absence, the foresight literature has oftentimes referred to "mismatches" between foresight and policy (Volkery and Ribeiro, 2009; e.g. Day, 2013; van Dorsser et al., 2020). In their assessment of a governmental foresight process in South Korea, Heo and Seo formulate it even more drastically: "Indeed, present policymaking has inadequately employed foresight. Sometimes, foresight becomes a mere cliché or an excuse to support power politics and thus turns into a means of deferring urgent and politically arguable decisions and actions." (2021, p. 12). In a similar vein, DaCosta et al. (2008) highlight the "symbolic function" of foresight i.e. signaling a long term orientation to the public or providing justification for a policy that has already been decided. However, there are also divergent appraisals. Choo and Fergnani (2022) present a case study of the successful adoption and institutionalization

of foresight in the Singapore Public Service. The study examines the factors influencing the institutionalization of foresight practices in the Government of Singapore, emphasizing the interplay between various actors and structures. The findings highlight the significance of institutional entrepreneurs in the adoption of foresight practices.

In this chapter, we want to contribute to this thread of research by introducing a conceptual framework that facilitates an examination of the institutional conditions in which foresight-policy interactions take place. While we endorse the collective efforts to advance the ontology, epistemology, and methodology that shape how we aspire to do foresight, we propose that the advancement of our understanding of the situated contexts in which foresight is done represents a crucial backdrop and often-missing piece for the development of the field. On the one hand, futures scholars recurrently reflect the epistemic foundations of foresight and (re-)construct its theoretical fundament (Inayatullah, 1990; e.g. Dator, 2019; Urueña, 2022; Fergnani, 2023). Foresight practitioners persistently strive to reflect on methods and design improved tools and approaches (Spaniol and Rowland, 2019; e.g. Cuhls, 2020; Schirrmeister et al., 2020). On the other hand, decades of research on policy advice have taught us that simply providing 'better' methods does not necessarily result in 'greater' impact (Howlett, 2009; Hustedt and Veit, 2017b). Indeed, research and practice often appear to be preoccupied with a narrow focus on the supply side, thereby neglecting the role of institutional conditions (Edler et al., 2022). Thus, considerations evolving around methods need to be brought together with advancing our understanding of the contexts in which foresight-policy interactions take place.

Our particular research interest evolves around the following related question: How do the institutional conditions, working practices and routines of public administrations in government shape foresight-policy interactions? Instead of attempting to measure the impact of governmental foresight on policy decisions, we problematize, conceptualize, and illustrate institutionalization as a factor for the administrative capacity to absorb, interpret and adopt foresight in the context of government. This analysis complements the study of the initiation and circulation of innovation direction debates by foresight practices and public engagement. It enables the examination of the uptake of innovation direction debates within government. In this regard, the chapter also continues to scrutinise and explain the loose ends found in Chapter 5.

For the purpose of this chapter, the term "institutionalization" is defined as a process that shapes the formation of working practices and routines. We hope to reduce

both disappointment and overstatement regarding the role of foresight in policy action and provide a nuanced understanding of foresight practices in government. To achieve this purpose, we first introduce core concepts from public administration research and relate them to the discussions concerning policy advice and foresight more specifically. This blending of discourses provides the theoretical grounding for an integrated perspective on the institutionalization of foresight in section three. Subsequently, we present an empirical illustration of the application of this public administration perspective on governmental foresight. To this end, we draw from a case study on the institutionalization of foresight within the German Federal Government, in which we investigate the institutionalization of foresight in multiple ministries and policy sectors. Notwithstanding the particularity of the German case, our objective in the discussion section five is to elucidate issues that are perceived more widely and to elaborate on the relationship between institutionalization and what is been perceived as mismatches and loose ends. The chapter concludes with a consideration of the potential for research on institutionalization to both problematize and help advance foresight-policy interactions.

The public administration perspective on policy advice

The coordination and formulation of draft policies is one of the main functions of ministerial bureaucracies. Civil servants in government departments have traditionally been described as prime policy advisers of the minister in parliamentary democracies (Halligan, 1995). Even though there is a broad consensus that the era when impartial civil servants were the primary policy advisers has passed (Howlett and Migone, 2013; Craft, 2015; Diamond, 2020; Peters and Savoie, 2025), they are still important actors in the policy process (e.g. Schnose, 2017). The assumption that impartial civil servants are 'speaking truth to power' by providing the best available knowledge base to political decision-makers is, however, much too simplistic. The policy cycle model, for instance, is not considered as a realistic description of the policy process. Instead, it is used as a heuristic for analytical purposes. Real policy processes have been unmasked as being much less rational and linear (Jann and Wegrich, 2017).

Policy advice serves two main purposes in the policy process: rationalization and legitimization (Hustedt and Veit, 2017a). Rationalization involves enhancing the knowledge base of political decision-making. It assumes that policy-makers seek advice to identify and evaluate policy alternatives, and to finally make evidence-based policy decisions. The legitimizing function of policy advice suggests that

policy-makers seek advice to pursue strategic goals, such as gaining time while simultaneously signalling activity or gaining expert support for a policy decision that has already been agreed on to enhance its acceptance by the voters.

Governmental foresight models typically overemphasize the rationalization function and underestimate the legitimization function of policy advice (Da Costa et al., 2008; Monteiro and Dal Borgo, 2023; Washington, 2023). This is problematic because the causes of a lacking impact of foresight in actual policymaking can only be understood when reflecting on the legitimizing function of policy advice as well. Policy negotiation processes frequently do not occur in an argumentative mode; rather, they entail a balancing of interests. From this perspective, policy actors would only ever select from foresight studies those elements that align with their own position. It is a somewhat idealistic assumption that foresight can lead to a shift in interest-based policy positions through the use of compelling arguments. However, institutionalization of foresight in government can bring about changes in the composition of actors and the mechanisms through which policy solutions are negotiated. For this reason, the way in which foresight is institutionalized affects the likelihood that foresight will influence the design of policies.

Ministerial civil servants are those civil servants who work in government departments (ministries). Ministerial civil servants differ from other bureaucrats in their specific task profile — they are typically less involved in enforcement and implementation tasks and instead engaged in policy formulation and coordination. Their role is more closely linked to politics, which is why they are often described as acting in a highly politicized environment (Aderbach et al., 2010; Cooper, 2021). As advisers of the minister, they are both on the supply and the demand side of policy advice: They 'translate' political advisory demands into concrete consulting assignments, they obtain expertise from subordinated agencies, they interact with a variety of internal and external stakeholders and advisers for the purpose of information gathering and knowledge building. When preparing policy advice to political decision-makers, they are predestined for fulfilling both the rationalization and the legitimatization function of policy advice. Their comprehensive knowledge of the policymaking process in government, their political responsiveness and their ability to anticipate the political implications of policy proposals make them suitable knowledge brokers (e.g. Høydal, 2020). In other words: ministerial civil servants have the knowledge, ability and access to increase the policy impact of foresight. Unlike most external providers of advice, they are able to take political factors such as timing, wording, strategic linking of different policy issues or initiatives or linking of policy solutions with current policy problems into account when giving policy advice.

From this perspective, it may appear surprising that the literature constantly criticizes the inadequate utilization of available knowledge in policymaking (Volkery and Ribeiro, 2009; Day, 2013; van Dorsser et al., 2020). It becomes evident that the 'impact problem' described in the foresight literature is not exclusive to foresight but rather reflects a broader issue: the existence of relevant knowledge does not automatically translate into its incorporation into the policy advice provided by ministerial civil servants, and even when more substantial advice is offered, it does not necessarily have an impact on the final policy decision (e.g. Edler et al., 2022).

In order to better understand these phenomena, it is helpful to reflect on some core characteristics of the government bureaucracy. Government departments (ministries) are organized along ministerial portfolios, and their internal organisation is – as it is typical for bureaucracies in general – characterized by a high degree of functional specialization and a rather strict hierarchy. Those characteristics have often been criticized as cementing established patterns of policymaking, fostering silo-thinking and hindering innovation (Hustedt and Seyfried, 2016; Ritz and Schädeli, 2022). Regardless of this criticism, reform attempts are often little successful and lead, at maximum, only to small and incremental changes.

The main reason for this is that the described features of bureaucracy fulfil important functions as described early on by Max Weber (2009). Functional specialization, for instance, secures professional competence and regulated responsibilities. The other side of the coin is what Herbert A. Simon described as "selective perception" (Simon, 1947): each administrative unit is focussing on its own area of responsibility, problems outside this area as well as interdependencies between different areas are not recognized and thus ignored in administrative action (including policy advice). In a similar vein, 'negative coordination' is considered a consequence of functional differentiation (Peters, 2018). Negative coordination in governmental policymaking means that the initial policy draft is prepared by one single department with primary responsibility for the issue. Other departments get involved later on in the process in order to check the draft on interferences with their own policy preferences (Radtke et al., 2016). Conflicts can escalate into "turf wars" (Finke, 2020), they are usually solved by negotiating compromises between departments. The final compromise can ignore or even oppose the available knowledge as it is a political compromise based on negotiations in a political environment. Moreover, synergies between different policy proposals are usually not recognized. For cross-cutting policy issues – or 'wicked problems' – the established portfolio structure and 'negative coordination' as the standard coordination practice in government form severe challenges, and this is also true for overcoming the impact impasse of foresight (Danken et al., 2016).

Public administration scholars and organization researchers underline that attempts to improve the consideration of knowledge on long-term societal developments and (intended and unintended) policy consequences in different areas within government departments requires a successful process of institutionalization (e.g. Edler et al., 2022). Experiences with the implementation of Impact Assessments show that there are large implementation deficits due to insufficient institutionalization. In many cases, Impact Assessments are formally implemented to fulfil legitimization purposes but do not change the policy process substantially (Veit, 2009; Staronova, 2010; Wanckel, 2023). Research on 'wicked problems' reveals that the implementation of new organizational structures (e.g. inter-departmental working groups) is not sufficient but has to be accompanied by profound changes in organizational culture and established routines (Radtke et al., 2016; Alford and Head, 2017; Daviter, 2017). Thus, a nuanced conception of institutionalization is key to understand (and improve) foresight-policy interactions.

Conceptual framework

Public administration scholarship has developed manifold concepts for understanding institutionalization. What these perspectives have in common is a focus on the establishment of routinized habits in organizations. This can be explained as the result of rational decisions, imitation or reproduction (DiMaggio and Powell, 1983). The sociologist Richard W. Scott (2008), offers an integrated perspective to understand institutions. According to his perspective, institutionalization consists of three pillars: regulative, normative and cognitive-cultural. In practice, the regulative pillar is often overemphasized, while the two other pillars receive too little consideration. However, a successful institutionalization depends on the interplay of appropriate regulative, cognitive and normative conditions within policymaking organizations (Edler et al., 2022).

For the purpose of our study, we slightly adapt Scott's concept by splitting up the regulative pillar of institutionalization in two distinct dimensions: organization and regulation. Consequently, we use four dimensions of institutionalization in our analytical framework (figure 9): organizational, regulative, normative and cognitive-cultural. The organizational dimension focusses on the establishment of organizational responsibilities for foresight in government. The regulative dimension focusses on regulative rules to conduct foresight studies in policymaking. The normative dimension focusses on social obligations to act in a distinct, foresight-oriented manner in policymaking. Finally, the cultural-cognitive dimension

focusses on the question, in how far foresight thinking is embedded in the existing administrative culture and perception patterns. This includes the question, whether civil servants have an adequate knowledge base for foresight. In the next section, we apply the analytical framework to the case of the German federal government in order to identify barriers for the use of foresight findings in policymaking and options to better institutionalize foresight in government.

Figure 9 Conceptual framework to study the institutionalization of foresight in government (own illustration) based on Scott (2008).

Data and methods

The findings presented in this chapter are based on a case study conducted from 2021 to 2022. Studying foresight-policy interactions within the German Federal Government through in-depth expert interviews with 31 civil servants, meetings and grey literature, proved to be an insightful case for understanding the institutionalization of foresight. The research was carried out during the final phase of Angela Merkel's term in office, when she led a coalition of conservatives and social-democrats. This government may be characterized as relatively traditional in that no reforms were implemented change the way the government apparatus worked.

The sample of interviewees was selected with great care to align with the specific objectives of our research. Firstly, to transcend the boundaries of specific policy domains, it was decided that a minimum of one civil servant from each ministry should be interviewed. Secondly, in order to give due consideration to the differing assessments of foresight within the hierarchy, interviews were conducted with civil servants at both the operational (civil servants without management function, section heads) and management levels of the respective ministry (heads of directorate, director-general or administrative state secretary, see annex). Thirdly, the interview partners were selected on the basis of their prior experience engaging with foresight.

Indeed, the majority of the officials interviewed had previously commissioned foresight studies or had worked in or managed a foresight group.

It should be noted that, despite the broad range of interview partners, this study does not claim to provide a comprehensive overview of all activities that aim to support governmental foresight. Instead, the interviews focus on questions considering the institutionalization of foresight. In the course of interviewing, we refrained from providing a strict definition of foresight. Instead, we introduced international best practices that exemplarily stand for governmental foresight at large while also leaving room for associations from the side of the interviewed civil servants. Like this, we aimed to trigger practical understandings of foresight as a practice instead of engaging in definitory discussions with civil servants.

The interviews followed a semi-structured guideline, which we developed based on the concept of institutionalization described above. The first part of the interviews comprised three main questions. What is the current status of strategic foresight adoption within your unit, division and ministry. What existing practices favor or impede the implementation of more anticipatory policymaking? What would you expect from an institutionalization of foresight in the government? In the second part, interviewees were presented with different options for institutionalization of foresight in the government and asked to assess the advantages and potential problems of each option. The options addressed the four dimensions of institutionalization outlined in the previous section and had been previously refined in with a group of selected government officials.

All interviews were recorded and transcribed. Following an open coding approach for a qualitative content analysis (Corbin, Strauss 2008), two researchers developed codes and sub-codes independently from each other to classify and condense statements. We used the MaxQDA software to conduct this analysis. Recurring themes in our data set included: arguments depicting the necessity of governmental foresight; descriptions of barriers to anticipatory policymaking; information regarding the status-quo of institutionalization of foresight in government; thoughts concerning central actors and their respective roles; recommendations for the continued institutionalization of foresight-policy interactions and perceived risks of introducing new institutional designs. The research team discussed and compared the assigned codes and merged the codes in a comprehensive code-book that comprises 65 codes. Subsequently, the interview data was triangulated through an assessment of statements identified in government reports and assessments pertaining to foresight. Moreover, the preliminary findings were presented first to a group of 16 civil servants from all

ministries in a meeting and then in a separate meeting to foresight practitioners. The key statements from both events were used for validating findings. For this chapter, our particular interest is to analyze, to track and to construct relations between the code set "barriers to anticipatory policymaking", the set "institutionalization" and the set "policy directions".

The context: Development of foresight-policy interactions in the German Government

Before turning to the case study, some context information on the German federal government is necessary. Germany is a parliamentary democracy. General elections take place every four years and the federal government is typically formed as coalition government of two or three political parties. The federal government consists of the federal chancellor and federal ministers. Federal ministries in Germany exhibit a strict hierarchical and linear structure as a result of the constitutional principle of ministerial responsibility. Each ministry is led by a single minister. Despite the requirement for a cabinet majority to pass laws and significant policy programs ('cabinet principle') and the federal chancellor's responsibility for setting general policy guidelines ('chancellor principle'), German federal ministers possess a relatively strong position compared to their counterparts in many other countries. They exercise independent control over their ministries and policy domains ('departmental principle'). As a result, ministers are not subordinate to the head of government and cannot be instructed on how to handle specific matters within their ministries. In the process of policymaking, the departmental principle grants significant autonomy to the lead ministry in making procedural decisions and consulting interest groups (see e.g. Kuhlmann and Veit, 2021).

Germany has a long tradition in attempts at strengthening future-oriented government. Today, contemporary historians and public administration scholars classify the period between 1963 and 1973 as the "planning decade" (Ruck, 2020) or the phase of "planning euphoria" (Jann, 2009). The early history of the institutionalization of strategic foresight in Germany also falls into this period. First futures and foresight think-tanks who claimed to shape politics occurred in the 1960s (Kreibich, 1991; Steinmüller, 2012; Pausch, 2016). Pioneers such as Robert Jungk, Ossip Flechtheim, Rolf Kreibich and many others founded the first institutions, especially in the non-university research sector. The aim of these institutes was to support decision-makers in policy, administration, research and business with anticipatory knowledge. In this early phase of its institutionalization, strategic foresight quickly

gained in importance. For example, the literature mentions that the planning staff of the Federal Chancellery under Willy Brandt called in foresight practitioners as consultants (Kreibich, 1991, 85 f. after Steinmüller 2012). An institutionalization within the German government was however not visible. In the course of the 1970s, observers attested to an increasing loss of significance of futures and foresight (ibid.).

It was not until the turn of the millennium that futures and foresight received more attention in Germany again. The field of science, technology and innovation policy was one of the first to establish foresight activities and commence with institutionalization. With the opening-up of innovation policy in the 2000s, innovation policy oriented foresight broadened its scope from merely scrutinizing technological developments, to include innovation directions relating to societal change and environmental transitions, thereby also diffusing to other policy fields (Smits and Kuhlmann, 2004; Daimer et al., 2012). In 2013, the newly elected German government committed itself to strengthening foresight in their coalition treaty. As a consequence, new foresight units were founded in some departments. New units, for example, aimed at supporting foreign and security policy with early crisis detection, or social policy with research on the future of work and value creation. Additionally, inter-departmental foresight capacity building has recently been strengthened by the foresight methods seminar at the Federal Academy for Security Policy and by strategic foresight inter-departmental working group. According to the federal government answering an interpellation from the German parliament at the end of 2022, most ministries had the aspiration to increase their budgets for strategic foresight (from over 10 Mio € per year to requested 12,6 Mio € for 2023) (Deutscher Bundestag, 2022).

Results: Institutionalization of foresight in the German government

In this section, we present our findings along the four dimensions of institutionalization. We analyze the interviewees' descriptions of the status quo of the institutionalization of foresight in the German Federal Government as well as their perceptions concerning deficits and expectations.

Organizational institutionalization

The Federal German Government has established a number of units whose primary objective is to engage in strategic foresight. At the time of the interviews, a total of 35 civil servants were primarily responsible for foresight-related topics. Some ministries had dedicated foresight units, including the Ministries of Defense,

Foreign Affairs, and Education and Research. Another foresight unit within the Chancellery functioned as an interdepartmental platform for exchange and provided support for foresight work within the departments. In addition to these dedicated foresight units, interviewees emphasized that governmental foresight in Germany is typically organized at the staff level. In this context, civil servants in operational units frequently engage external providers to implement foresight processes. In this context, the Federal Ministry for Education and Research, which has a contracting budget of €4.26 million for the 2022 fiscal year, is particularly noteworthy. Furthermore, the Ministries of Defence and the Interior are each allocated an annual budget of between two and three million euros.

Another form of organizational institutionalization of foresight that interviewees highlighted is the establishment of think tanks, policy labs, or academies that are linked to single departments but are granted relative independence. Notable examples include a think tank for strategic foresight established by the Federal Ministry of Labour and Social Affairs in 2018 and a small unit within the German Environment Agency, which operates under the jurisdiction of the Ministry of the Environment.

The findings of the interview analysis indicate that there is no uniform model of organizational institutionalization of foresight within the German federal government. Some ministries prioritize the development of internal foresight capabilities, while others prioritize the engagement of external providers. The interplay between management levels, operational units, subordinate authorities, and external providers varies across ministries. A few interviewees were unaware of any foresight processes within their department. The decentralized organization of foresight-policy interactions in the German federal government arises from the departmental principle, which entails the relative independence of each ministry.

The interviewees unanimously emphasized the strong departmental principle and the subsequent prominence of silo thinking as the main barrier for future-oriented policymaking. They described how the lack of a ‘space' for overarching deliberation is inhibiting discussions about novel phenomena that do not yet have an “owner” within the organizational structure. From within one of the “silos” it is almost impossible to overcome this "ownership problem". One interviewee underlined that in coalition governments, policymaking is typically conflictive and not "think tank work". While the small foresight unit at the Federal Chancellery provides a platform for exchange and dialogue between governmental foresight actors (roundtable), it has no mandate to truly coordinate foresight activities in government or to intervene in the affairs of single departments.

Within ministries, the interviewees criticized insufficient linkages between foresight units and units steering policymaking and legislative work. That is, policy directions are shaped through political practice and not foresight. The hierarchical standing and power of units engaged in conducting and commissioning foresight were described as relatively low. The majority of these activities are perceived to be oriented towards providing support at the operational level. Tasks are managed through a clearly delineated division of responsibilities and processed along vertical hierarchies. According to one interviewee, large administrative structures are not particularly adept at fostering creativity and idea generation. Instead, they tend to excel in the assignment of responsibilities and the definition of competencies. In the interviewees' opinion this serves the comprehensibility of administrative action, but simultaneously constrains the scope for creative thinking and the exploration of alternative pathways of change. In the case of foresight, with its focus on trends, change processes and strategy, it is not sufficiently clear to what thematic unit it belongs, how actors develop a sense of shared ownership and who can claim leadership. Foresight, one interviewee reasoned, always extends over several "allotments", each of which is overseen and safeguarded by their respective "tenants". These tenants, it was observed, are reluctant to tolerate any form of encroachment or intervention. Consequently, foresight is often likened to a "king without a kingdom," necessitating significant effort to align the various stakeholders and secure their buy-in. The interviewee asserted that it is exceedingly challenging to surmount the "ownership problem" within the confines of a single allotment, absent robust backing from the ministry's highest echelons.

In conclusion, the interviews demonstrate that there is a significant effort to institutionalize foresight within the organizational context. This encompasses the formation of specialized units for foresight, the designation of roles with foresight responsibilities, and the allocation of increased budgets for foresight initiatives. However, the organizational institutionalization of foresight does not adhere to a uniform model. Some ministries prioritize the development of internal foresight capabilities, while others engage external consultants to conduct foresight studies. Our interviews reveal great variance between ministries. Furthermore, the interviewees lament an "implementation deficit", i.e. missing links to decision-makers within departments that restrict uptake of innovation direction debates from foresight. This is further amplified by the lacking inter-ministerial coordination. Table 8 summarizes these findings.

Table 8 Indicator assessment of organizational institutionalization

Indicators from conceptual framework	Related questions to interviewees (selection)	Key findings
Existence and relevance of units	What foresight activities have there been in your department, and which are in the planning stage? Can you recall any specific foresight publication or process that particularly impressed or influenced you?	Some units dedicated to foresight Variation in standing, typically limited influence
Coordination	With which other processes would foresight need to be aligned with and coordinated? In your experience, what are the most important factors for ensuring that foresight results are used for specific processes?	Missing links to decision-makers Low level of coordination (mainly exchange) through chancellery
Dedicated resources	What resources can you draw upon for foresight (personal and material)?	Staff responsible for foresight in all ministries Only few teams (foresight often the responsibility of one sole person, except in three departments) In some units substantial budgets for contracting (mainly for technical infrastructure and foresight studies)

Regulative institutionalization

In their interviews, the officials highlighted the coalition agreement as the principal instrument for securing political commitment and initiating processes within the government. The implementation and referencing of the coalition agreement are regarded as the principal mode of working in the German federal government. While some interviewees perceived this as an unduly restrictive framework and criticized the purely operational and static view of political planning that is disconnected from external events, there was consensus that the coalition agreement determines day-to-day business. The initial mention of foresight in the coalition agreement in 2013 was identified as a primary catalyst for the implementation of processes and the establishment of new units. For foresight to become more than an additional exercise alongside the operationally relevant tasks, the interviewees suggested to not only mention it in the coalition agreement, but to specify concrete processes and objectives.

In addition to the coalition agreement, the German Federal Government has established formal procedures for evaluating the impact of legislation. These impact assessment rules are laid down in the Joint Rules of Procedure of Federal Ministries. According to these rules, it is mandatory for all ministries to assess the intended and unintended consequences of each government bill. This includes, among others, an ex-ante assessment of the bill's environmental impact. Nevertheless, despite its future-oriented control mechanisms, our interviewees have noted that it does not represent a fully-fledged example of regulatory institutionalization of foresight. The assessments in question typically rely on predetermined indicators, which is at odds with the majority of foresight approaches that emphasize the necessity for openness and the consideration of alternative scenarios.

Interviewees highlighted a potentially significant ruling by the Federal Constitutional Court. The "climate ruling" mandates that if political goals are set for the future, an explanation must also be provided for how they will be achieved. This ruling may compel government politicians to be more explicit about their plans, roadmaps, or scenarios. It was postulated by the interviewees that this could compel the government to adopt a more forward-thinking approach. In this case, some interviewees posit that institutionalizing foresight would serve to guarantee the implementation of principles such as intergenerational justice and intertemporal freedom. Upon inquiry regarding the proposal to implement binding procedures to enhance the integration of foresight in the formulation of future-oriented policies, such as incorporating foresight into the Joint Rules of Procedure of the Federal Ministries, the interviewees expressed reservations. Many expressed concerns that such a form of regulatory institutionalization could potentially render foresight ineffective and merely symbolic, akin to a "paper tiger." Similarly, interviewees expressed skepticism regarding the implementation of a reporting system, such as the one in Finland, where the Government Report on the Future and the Parliament Report on the Future require ministers to prepare, implement, and interpret foresight activities on a yearly basis.

In conclusion, the majority of interviewees indicated that there was no discernible regulatory institutionalization of strategic foresight within the German federal government. The interviewees expressed skepticism about the idea of fostering the institutionalization of foresight through binding procedures. Instead, they viewed the inclusion of foresight activities in the coalition agreement as a potential avenue for regulatory institutionalization. Based on the interviews conducted, it can be concluded that currently, there are no procedures in place to regulate the utilization of foresight or to impose sanctions for the absence of foresight implementation in

the German Federal Government. The uptake of initiated and circulated innovation direction debates is thus restrained in this dimension. Table 9 provides a summary of these findings.

Table 9 Indicator assessment of regulative institutionalization

Indicators from conceptual framework	Related questions to interviewees (selection)	Key findings
Existence of rules	Are there any official rules that oblige or incentivize you to use foresight? Imagine that foresight would be an official requirement in the rules of procedure of the government… How would that shape your working routines? Is it desirable?	Coalition agreement seen as main lever for institutionalization of foresight No formal procedures in place Ruling of constitutional court seen as opportunity for establishment of rules in the future
Existence of sanctions	Are there any sanctions if you do not consider a foresight perspective in your work?	No formal sanctions, constitutional court can force the government to explain how political goals can be met in the future

Normative Institutionalization

Government officials underscored the significance of capacity building as a pivotal factor in the establishment of informal networks. The foresight methods seminar at the Federal Academy for Security Policy was perceived as a significant contributor to the formation of interdepartmental networks among civil servants. Although numerous interviewees observed a considerable demand among civil servants to participate in the training, which is perceived as a beneficial opportunity for career advancement, only a limited number of civil servants, approximately a few hundred, have taken part so far.

A significant number of interviewees expressed a clear need for innovative approaches to collaboration that transcend the boundaries of policy areas, ministries, or even departments. New forms of horizontal coordination, which facilitate the growth of knowledge beyond the sum of individual insights, are required with great urgency. The argument put forth by numerous interviewees is that only through policy strategies that transcend the individual perspectives can the intricate challenges of the future be effectively addressed. One interviewee identified the necessity of "mobilizing swarm intelligence." The interviewees underscored the significance of informal exchange with other departments, beyond mere "co-signing rounds" and formal occasions, such as the inter-departmental foresight working

group at the chancellery. The interviewees underscored that the constitutionally enshrined departmental principle provides a foundation for the establishment of more coordinated accompanying processes. Furthermore, it is essential that the collective added value is transparent and accessible to all parties involved. As one civil servant aptly observed, this approach aims to ensure that the sum of the individual contributions exceeds the original expectations. It is noteworthy that this was less discussed in the context of establishing foresight as an institutionalized process, but rather as an anticipated outcome of such a process.

One interviewee posited that the training and socialization of leadership are of paramount importance in the institutionalization of innovative methods. The private sector is regarded as being more advanced in this domain due to the receptivity of managers and younger employees to novel concepts. However, this disposition must be espoused by both current and prospective leaders in the public sector. The perceived efficacy of existing career pathways in fostering an innovative and collaborative leadership culture exhibited considerable variation across departments and ministries. Some respondents observed that individuals who demonstrate commitment and interest beyond their assigned area, including foresight, are rewarded for their efforts. However, other respondents indicated that the expeditious processing of urgent tasks was prioritized over long-term and strategic thinking.

In conclusion, the formation of horizontal networks, the establishment of positive coordination, and the demonstration of leadership commitment for the implementation of foresight are identified as pivotal elements in the institutionalization of foresight. Concurrently, our interviewees perceive no social obligation to discuss results from innovation direction debates from arenas outside the government nor to engage with foresight activities within government, which has resulted in minimal normative institutionalization. At the time of the interviews, the prevailing view was that capacity building represents the primary site for normative institutionalization. Table 10 provides a summary of these findings.

Table 10 Indicator assessment of normative institutionalization

Indicators from conceptual framework	Related questions to interviewees (selection)	Key findings
Certification / accreditation	Do you know of foresight capacity trainings in your domain?	High demand for foresight seminar
Informal networks	Where do you discuss foresight?	Several personal networks in place fostered by training activities, meetings and inter-departmental foresight working group
Expectations	In what kind of processes did you find it particularly interesting to use foresight? Why? Can you imagine others? How do you discern success? What are bottlenecks?	Some report foresight-like activities are highly valued and rewarded Some see it as career-obstructing

Cognitive-cultural Institutionalization

Against the backdrop of recent events, including the global pandemic, several interviewees underscored the necessity for the establishment of novel modes of working in government. These new modes of working are seen as a means of fostering the anticipatory capacities and resilience of government in the face of growing uncertainties. However, the interviews revealed no discernible consensus regarding the specific implications of this approach, the means of achieving it, or the concrete practices that would be involved. Instead, many of the arguments for institutionalizing foresight in government given by the interviewees in this context were based on international comparison. A common observation was that Germany would benefit from learning from international best practices. In this regard, the United States, the United Kingdom, Finland and Singapore were often mentioned.

According to our interviewees, government politicians are very much caught up in day-to-day business and focus on media resonance. The interviewees characterized this phenomenon as a "fixation on the present," an "adhocracy," and a "tyranny of the urgent over the important." In the absence of an immediate benefit to daily operations, foresight processes are frequently unattractive to decision-makers. Given the limited availability of attention, it was questioned whether government politicians would engage with scenarios. A forward-looking perspective would be regarded as an indulgence rather than a necessity. The counteraction of this fixation on the present was identified as a central function of strategic foresight.

Furthermore, the interviewees indicated that they perceive a tendency to avoid confronting potential risks and adverse outcomes. A significant number of respondents indicated that a forward-thinking culture of innovation and risk-taking is not yet well established in Germany. Additionally, there seems to be a pervasive reluctance to embrace experimental approaches with uncertain outcomes. In this regard, some interviewees observed that a lack of widespread knowledge of foresight and its methods contributes to low acceptance and even aversion.

A frequently cited obstacle is the concern that politicians, media figures, and the general public may not be equipped to handle unfavorable outcomes. In particular, scenarios with low probability and negative connotations are frequently misinterpreted in terms of predictions or even plans. Consequently, numerous government officials are purported to be reluctant to disclose their scenarios to the public. What is needed according to our interviewees is a deepened public understanding of what foresight is and what goals it pursues.

In conclusion, foresight is not regarded as an inherent component of policymaking in the German Federal Government. There is no shared language or understanding of foresight, which renders it a practice that must be explained and justified. Even if justification is successful, foresight must compete with tasks that are commonly perceived as more urgent and are therefore embedded in organizational logics. Nevertheless, the interviewees anticipate a shift towards novel organizational cultures, public sector innovation, increased experimentation, and a new culture of failure that could be partly propelled by foresight and simultaneously enhance its acceptance. Table 11 provides a summary of these findings.

Table 11 Indicator assessment of cultural-cognitive institutionalization

Indicators from conceptual framework	Related questions to interviewees (selection)	Key findings
Common beliefs and perceptions	Can you imagine that principles of foresight, such as systemic thinking, long-term thinking, thinking in alternatives and questioning assumptions, could be firmly anchored in the working culture of the ministry?	Shared narrative of increasing uncertainty and risk Perception of overwhelming daily business and urgency Skepticisms towards public understanding of foresight findings (in particular scenarios)
Shared knowledge of foresight	How would you define foresight? Do you know of different understandings?	Confusion about definitions and what practices count as foresight Emerging shared knowledge through training
Mimetic isomorphism	What are the best cases of governmental foresight for you?	Strong recognition of practices in other governments, but no direct emulation

Discussion of results: Institutionalization as a framework for understanding foresight-policy interactions

The analysis of the interviews indicates that there are several deficiencies in the institutionalization of foresight within the German government. Although the presented statements of the interviewees indicate a growing organizational institutionalization of foresight, the interviews also demonstrate a lack of institutionalization, particularly with regard to the regulative, normative, and cognitive-cultural dimensions. This deficit can be attributed to several factors, including inadequate organizational structures, the absence of formal rules, a lack of social pressure, and insufficient attention given to foresight in policymaking, as described by the interviewed civil servants. Furthermore, it is noted that the concept of foresight does not readily align with the existing structures and procedures of the ministerial bureaucracy. The interviews corroborate the observations made by public administration scholars regarding the existence of certain challenges, such as "selective perception" and "negative coordination" (see section two and empirical illustrations such as "allotments" and "adhocracy" in section 6).

For public administration scholars these findings are not surprising or new. Functional differentiation and its consequences in state bureaucracies are well studied and understood. However, what do they imply for our understanding of foresight-policy interactions? The deficits perceived by the interviewees resonate clearly with the notion of “mismatches” often brought to the fore in the foresight

literature (Volkery and Ribeiro, 2009; e.g. Day, 2013; van Dorsser et al., 2020). While our research indicates that both innovation direction debates stemming from arenas outside the respective departmental responsibilities as well as foresight practices inside government fail to garner sufficient attention in the political-administrative system, we do not agree with the term 'mismatch', which suggests a generic incompatibility. Rather, we propose the term 'loose ends' to signify that foresight practices are undertaken, seek to link to the chains of activities within government, but fail to couple due to an absence of sufficient institutionalization.

The interplay between missing regulative institutionalization (i.e. no formal rules and no formalized control or sanctioning procedures), lacking normative institutionalization (i.e. no social pressure) and poor cognitive-cultural institutionalization (i.e. no attention or shared understanding) constitute loose ends in foresight-policy interactions. While governments may allocate material resources to conduct foresight, there are no coercive, nor mimetic, nor epistemic forces to ensure that the results of foresight processes are absorbed in policymaking. This impedes the circulation of foresight practices and results, so policy actors do not afford them a high level of importance or serious consideration. A 'loose end' has thus to be understood as a result of an incomplete and uneven institutionalization: Organizational institutionalization allows foresight to materialize, but the missing other dimensions of institutionalization make it incommensurable for uptake in the organizational environment. In this context, governmental foresight may be viewed as informative, but it remains largely irrelevant for policy analysts and decision makers in government. Thus, innovation direction debates often remain isolated from each other. Foresight cannot ensure their uptake in government where the directionality of policies aimed at steering socio-technical change processes is negotiated.

A rebalancing of uneven institutionalization of foresight in government is not easily achieved. Promoting other institutionalization dimensions of foresight may only shift problems. For instance, many of our interviewees warned of advocating for a stronger regulative institutionalization. In this version of an uneven institutionalization few resources, lacking social obligations and a missing belief in the value of foresight, in their view, would turn foresight only into a bureaucratic burden. The only option that a majority of interviewees saw as a somewhat realistic way out of this impasse was the installation of a cross-departmental foresight unit within the government (Warnke et al 2022). Such a “futures lab”, so it was argued, could help to overcome many of the barriers mentioned above and contribute substantially also to the cultural-cognitive and normative institutionalization dimensions and thereby strengthen the whole government’s reflection and absorption capacity. At the same time, interviewees

and discussants expressed skepticism regarding the realistic achievement of all the necessary conditions for this significant organizational innovation. Among these conditions were mentioned the need for high-level support, a clear mandate, shared ownership across ministries, and the sufficient attractiveness of the lab positions as a career incentive.

It is an open and pressing question how ideal conditions could precisely look like. In order to foster the organizational embeddedness, facilitate its regular use and uptake in policymaking, it is essential to address all pillars of institutionalization. While resources, trainings and networks are important, their effects on institutionalization will remain elusive if no appropriate rules are integrated consistently into the prevailing processes of strategic planning, policy development and law preparation. If the implementation of novel practices already represents a significant challenge for actors within government than the integration of practices from different levels and scales poses an even greater challenge. The involvement of external actors is likely to result in an intensification of complexity, as demonstrated by research on the interaction between federal and regional arenas (Priebe and Herberg, 2024). Conversely, external pressures from parliament, courts, media, science, and civil society have the potential to exert influence and ensure that innovation direction debates cannot be disregarded in government.

Conclusion

The study presented in this chapter emphasizes that the sheer existence of governmental foresight units and dedicated budgets does not necessarily lead to proactive and forward-looking policymaking. We argue that one conducive factor for avoiding loose ends in foresight-policy interactions and facilitating absorption of results consists in its institutionalization along all dimensions (organizational, regulative, normative, and cognitive-cultural). Political attempts to strengthen foresight in policymaking often focus one-sidedly on individual dimensions, especially the organizational dimension, while widely neglecting the other dimensions.

While this perspective helps to explain how prevalent practices, institutional conditions and working routines of public administrations in government shape foresight-policy interactions, it does not provide an easy fix. As decades of public administration scholarship has shown, talk about deficits is always part of administrative reforms and public sector innovations.

With regard to the question of governmental foresight in the German Federal Government, our analysis leads us to conclude that there is a lack of institutionalization that presents an obstacle to the adoption of foresight practices and the absorption of the resulting bodies of knowledge. This deficiency arises from inadequate organizational frameworks, the absence of formal rules, the absence of social obligation, and insufficient attention towards foresight. The interviewed civil servants emphasized that foresight does not align well with the existing structures and procedures of the federal ministerial bureaucracy in Germany which are characterized by a strong departmental principle, resulting in 'turf wars' and 'negative coordination'. In order to increase the potential forward-looking capacities of the German federal administration, three context-sensitive models of institutionalization were proposed elsewhere (Warnke et al., 2022). One of these models incorporates the aforementioned futures lab, while the others suggest varying degrees of central coordination through the Federal Chancellery. The models seek to pay attention to all dimensions of institutionalization.

It is not possible to generalize these recommendations beyond the specific context of Germany. Nevertheless, it can be concluded that the application of the conceptual framework developed and illustrated in this chapter facilitates the assessment of foresight institutionalization and associated barriers for uptake of foresight practices and findings in public administrations. This, in turn, allows for the scoping, fine-tuning, and implementation of foresight processes in a manner appropriate to the specific institutional context. It is our contention that future research aimed at adapting specific methods to particular institutional contexts will contribute to reducing disappointment in interactions between foresight and policy.

While we think that it is important to put forward proposals for supporting forward-looking policymaking, this chapter also advocates for modesty. No single method, institutional design, or reform can guarantee that innovation direction debates match the workings of an institutional context, or even that it creates an impact on policymaking. The findings of our research suggest that a purely rationalist approach to the adaptation of foresight is inadequate. Instead, we propose that governmental foresight is contingent upon the social, political and cultural features of the institutions in which it seeks to become embedded. Encouraging research collaboration between the foresight community and public administration scholars holds great promise in designing meaningful interactions with policy. Ultimately such a nuanced understanding allows for a reflexive stance, which acknowledges that foresight is not only an innocent sensorium for governments to explore, assess, preempt, imagine, speculate, co-create and experiment with socio-technical change, but that foresight lends itself to the politics of directionality.

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7. Conclusion

This dissertation has emphasized that directionality is a powerful notion in debates regarding socio-technical change. Against the backdrop of a recent hype of directionality as an object of research and policy, I have argued that questions concerning the shaping of pathways for socio-technical change are not exclusive to the transformative policy ambitions of recent decades but have always played a role. Rather than being limited to a specific historical epoch or policy domain, I suppose that speculating about how technologies may impact the directions in which societies develop is a salient motif in human history. What is peculiar about the contemporary directionality discourse, however, is its paradigmatic emphasis on framing the way to achieve intended change, such as sustainability transitions, or, more recently, rearmament, as a problem of innovation to be solved by the coordinating power of the state (Pfotenhauer et al., 2019).

I have shown how this directionality discourse has emerged as priorly disconnected fields have initiated a joint dialogue between economists, geographers and sociologists concerning research on and the practice of innovation policy. As such, STS, innovation and transition studies, established new links in academia, while simultaneously offering themselves as advisors, clients and critics of directionality questions for innovation policy. This thesis has demonstrated that these knowledge practices have resulted in a differentiation of directionality notions. While some notions highlight political and economic choices in the development of socio-technical pathways, others emphasize the structural conditioning of these pathways, and yet others stress the role of social embedding and appraisal for governing socio-technical change.

Integrating these findings into the practice-theoretical conceptual framing, I have argued that different directionality notions are brought into interaction through a set of formalized practices. That is, discussions concerning the material constitution of innovation systems, the political steering of innovation toward specific directions and the situated deliberation and social appraisal of innovation constantly interact with one another through state-driven innovation direction debates. These practices are organized in different communities, differ in their specific approaches and go by different labels such as foresight, policy consultations or technology assessment. What they share in common, however, is that they initiate discussions concerning the directions, pathways and velocities of socio-technical change. As part of a larger bundle of policy and knowledge practices, they bring about the active integration of the spaces, materials, know-how and meanings of directionality.

Based on this conceptual framing of *directionality in the making*, this dissertation has followed foresight practices across different contexts. Three case studies were presented to show how foresight initiates, circulates and facilitates uptake of debates for innovation policy. The findings presented in the chapters above show how directionality is practiced through policy-oriented foresight. They indicate that the theoretically presumed integration of directionality elements has limits. On the one hand, practices such as foresight constitute directionality as a discernible phenomenon in innovation policymaking. Scenarios enact the imagination and exploration of different pathways of socio-technical change and public engagement moves innovation direction debates across different arenas. On the other hand, the fractured communication corridors that channel innovation direction debates amidst a high degree of interpretive flexibility across different arenas produce loose ends that restrain integration. In this regard, the lacking institutionalization of foresight practices limits the potential uptake of debates in decisive directionality arenas.

While directionality in the making is a phenomenon enacted through many practices (e.g. policymaking, academic discourse, political maneuvering, lobbyism), state-driven practices such as foresight are of specific interest for my research as they play a pivotal, yet undertheorized, role in innovation policy. The findings of the case studies help us to elaborate more specifically on the role of foresight practices for directionality in the making. Rather than bringing about decisions and political commitment towards specific directions, pathways or velocities of socio-technical change, this practice, as observed in the case studies, puts emphasis on contingency. It does not crystallize in the form of a deterministic forecast of innovation processes (e.g. Moore's Law). Neither does it sustain salient models of diffusion of socio-technical change (e.g. the X Curve), nor does it develop a specific plan, strategic priorities or guiding narrative of progress. Instead, directionality remains always in the making.

If foresight practices are neither about decision-making nor negotiation nor about forecasting, what are they then? This conundrum regarding the role and value of foresight in the context of innovation policy has preoccupied the field of foresight for a while (Da Costa et al., 2008; Boston, 2016). While different functions have been proposed, they often remain disparate and undertheorized.

At the beginning of this thesis, I have suggested that foresight practices are a reaction of policymakers confronted with Collingridge's dilemma (Collingridge, 1980). If we follow Collingridge and suppose that it is impossible to predict socio-technical change and that discerning its concrete shape and effects can only happen at a

moment in time when it is too late to change its direction, then it becomes clear why foresight practices rather open than close discussions concerning future pathways of socio-technical change. The objective of these practices is to mitigate the risk of 'lock-ins', by fostering a culture of constant reflexivity regarding potential socio-technical developments. This approach emphasizes the importance of maintaining a high degree of flexibility in response to emerging innovation pathways and, thus, asking for a specific conceptualization of change and governance.

This point resonates with decades of sociological research on future-making. On the one hand, this line of research has shown how the future is tamed, traded and commodified and how future expectation and imaginaries become performative for controlling the present (Adam and Groves, 2007; Jasanoff and Kim, 2015; Beckert, 2016; Oomen et al., 2021). On the other hand, it was also shown that articulations of the future, such as utopias, can function as a critique of the present and break with the dominance of present conventions, routines and power structures (Bauman, 2009; Wright, 2010; Urry, 2016). In this latter reading, future-making allows for critique and reflexivity through imagining future alternatives. This may help to situate the "new appetite for critique and reflexivity in innovation policy" (Pfotenhauer, 2023) or reflexive governance in more general (Bauknecht et al., 2006; Voß and Amelung, 2016).

Based on the findings of this dissertation, I will argue that state-driven foresight practices in the context of innovation directionality debates are not only a source of reflexivity but also a legitimization for policy arrangements. Foresight, as a formalized, state-driven practice produces techno-political subjects and relates them to one another by reflecting the expectations that underpin innovation policy, multiplying imaginations of technological trajectories and socio-technical change, and articulating new issues as problems of innovation.

I dedicate this last chapter to theoretically delineating the social function of foresight for policy by leveraging the findings of the practice approach used in this research. By synthesizing findings from the empirical case studies and connecting them with arena theories, I will draw overarching conclusions for the role of foresight in innovation policy. My argument is that foresight practices mobilize directionality debates as social resources for arenas where decisions are made. Thereby, social resources, such as value commitment and social reputation, do not only influence the issue framing and agenda setting, but also provide legitimacy to arenas that function under the condition of the innovation imperative. This theoretically clarifies the conundrum concerning the role and value of foresight in the context of

innovation policy. Furthermore, it sheds light on a potential issue. I will argue that an inflationary use of foresight as a social resource runs the risk of diminishing the socio-political value of each directionality debate. Endlessly multiplying pathways of future developments can turn from a democratic practice into a political strategy to devalue and paralyze directionality debates reinforcing the non-politicization of innovation policy touched upon in the introduction.

The remainder of this chapter will provide the discussion necessary to elaborate this point further. It continues with a synthesis of the findings from the presented case studies, which leads the way towards overall reflections on directionality in the making as an element of innovation policy arenas. Furthermore, I outline the academic and practical contributions of this dissertation. At the end of this section, I reflect on the limitations of the dissertation and outline a future research program that seeks to problematize the hybris of foresight as well as the Eurocentric focus my research has had so far.

Synthesis and discussion of the case studies

The case studies have provided concrete illustrations of directionality in the making. They have shown how foresight takes different forms (ranging from knowledge management to expert deliberation, to public engagement, to policy advice) thereby linking otherwise disconnected elements of directionality through practice. Concretely the cases showed how foresight practices shaped the preparation and operationalization of the five missions of Horizon Europe, how they were used to generate multi-sited dialogue and learning for the articulation of directionality in the German High-Tech Strategy and how foresight-policy interactions, through more or less institutionalized working practice arrangements, effect the uptake of directionality debates.

Concretely, the cases have shown how foresight practices initiate, circulate and facilitate uptake of innovation direction debates in the context of three case studies. Chapter 4 sought to answer the question of how foresight initiates discussions regarding the directionality of innovation policy? Therefore, I refined the conceptual framing and developed an anticipatory practices approach that was used to study foresight in the context of innovation policy at the European Commission. The case study showed that by synchronizing disparate bodies of knowledge, expectations and temporal demands, foresight can set the scene for arenas where innovation directions are discussed in the pursuit of formulating and operationalizing

innovation policy. While it stays outside the decisive arenas in which policies are shaped, foresight practices initiate discussions concerning the directions and pathways of socio-technical change thereby corroborating the arenas' intersections between policymaking, science and society.

In Chapter 5, we showed how foresight is further used by state actors to move these emerging directionality debates and missions through different arenas to other spaces. Thereby, our research focused on the question, *what practices are involved in moving missions through arenas, how do actors therein respond and how does this process contribute to the shaping of directionality?* This is not a coercive move. Rather, the interactional process of regioning allows actors from different levels and scales to come together to make sense of innovation missions. The ambition to increase coordination is thereby dissolved into creating policy responsiveness and learning through feedback loops. While this holds the potential for democratization and pluralization of potential pathways, it can also result in loose ends.

The research question at the center of Chapter 6 has been developed in response to the observation of loose ends and asks *how do the institutional conditions, working practices and routines of public administrations in government shape foresight-policy interactions?* The research has shown that for an uptake of directionality debates from foresight to policymaking, the ministerial bureaucracy would need to be able to make sense of them. However, foresight practices do not readily align with the existing structures and procedures of the ministerial bureaucracy. We propose institutionalization (Scott, 2008) as a concept to understand how foresight practices are understood, demanded, learned and adopted by civil servants in the ministerial bureaucracy and how foresight aligns with working practices and routines in government. Institutionalization along all dimensions (organizational, regulative, normative, and cognitive-cultural) was shown to be a conducive factor for avoiding loose ends in foresight-policy interactions and facilitating absorption of results.

The institutionalization of foresight is only one of many ways by which directionality can be anchored in the state. Elsewhere (Wittmann et al., forthcoming), we have studied policy transformations and administrative reforms in Germany that aim to increase state capacities' to formulate and implement transformative and mission-oriented policies. There, we emphasize that dynamic capabilities, in particular the combination of creation and disruption of administrative structures and routines within the state, play a pivotal role for a consequential uptake of directionality debates. Dynamic capabilities refer to sense-making routines, which involve analytical assessment and information processing for learning; connecting routines

that build stakeholder support through networking; and shaping routines aimed at mobilizing resources and adjusting processes to implement new approaches (Kattel, 2022). While the institutionalization of foresight can be supportive of creating state capacities for transformative policies, it likewise depends on dynamic capabilities to allow the working practices in state administrations to innovate.

In conclusion, I propose to understand the presented concepts—synchronization, regioning and institutionalization—as the core dimension of directionality in the making. These three concepts explain initiation, circulation and institutional uptake of innovation direction debates. Beyond helping to describe practices that imagine, explore and debate if, how and for what purpose policy should steer innovation in specific directions, the three concepts support understanding directionality in the making as sequenced and iterative process within multi-actor constellations. As the case studies have demonstrated, they can be used for analyzing how different arenas are set up, brought into conversation with one another and delineate each other.

Overall findings, contributions and reflections

How is directionality practiced through policy-oriented foresight? To answer the question which I posed at the outset of this dissertation, it is necessary to extend the discussion beyond the case-specific insights that were discussed above. Utilizing the concepts employed in this dissertation, I explore the potential for generalized responses to the overarching research question. That is, theoretically elaborating on the role of foresight as a practice of synchronizing, regioning and institutionalizing innovation direction debates across directionality arenas. By doing so, I also aim to clarify the added value of combining the presented articles in one collection.

Foresight as a means of mobilizing social resources in directionality arenas

The arena metaphor has repeatedly come to the fore in this dissertation. Chapter 4 concluded that foresight sets the scene for arenas in which actors intentionally try to influence policy. Chapter 5 showed that rather than remaining in disparate arenas, foresight moves directionality debates through arenas at different scales and levels thereby co-constructing them. Different conceptualizations of arenas (Hilgartner and Bosk, 1988; Renn, 1992; Klerkx and Leeuwis, 2008; Schoen et al., 2011; Janssen et al., 2023) have allowed my research to connect the empirical focus on foresight practices with actors, institutions and the shaping of policies. As arena concepts allow understanding the ways in which actors in different constellations mobilize

social resources to influence policymaking, it helps to situate directionality debates within a broader, overarching context.

Theorizing about arenas is a particularly salient approach for examining the conditions for influencing policy in pluralistic, socio-spatially diverse and democratic societies. As observed in research on arenas in other policy domains, the mere availability of money or power alone are not sufficient for setting policy directions (Renn, 1992). In addition, sociologists have emphasized the role of persuasion and cultural meaning as social resources (Parsons and Smelser, 1956; Luhmann, 1982; Hilgartner and Bosk, 1988), which can be observed when legislative bodies of the state mobilize evidence, social influence and value commitment.

I propose to understand foresight practices as a way to mobilize social resources for policy arenas where the directionality of science, technology and innovation are in the making. Rather than being itself part of an arena, foresight practices are an input into the arena mobilized by state actors within the decisive policy arena. In spite of the state's dominant access to regulatory power in the field of science, technology and innovation, and its pivotal role as a funder, it needs to accompany policy processes with practices that explore and demonstrate the alignment of policy proposals with societal values and interests, future expectations, and evidence.

Societal values were found to play a major role for directionality. In this dissertation, they appeared as value articulations in grand challenges, visions and missions that portray normative goals and possible ways of their attainment. Examples of the mobilization of societal values through foresight practices may include the articulation of shared visions in mission boards or public engagement. Through synchronizing, they can persuade actors that innovation policy follows directions that are based on commonly shared values, interests and worldviews. The resulting value commitment extends mere coordination efforts or legitimizing framings for innovation policy. By ways of regioning, it contributes to shaping meaning and collective identities of innovation cultures ultimately promoting the emergence of a shared vision of how innovation can contribute to a 'better world'. Actors that became visible through this way were, amongst others, state officials and civil servants, civic and institutional entrepreneurs, and, to a lesser degree, technology entrepreneurs, firms and start-ups.

Future expectations have been shown to act as an expression of a social resource for directionality, with the practice of foresight mobilizing and synchronizing them to create trustworthy articulations of future pathways for innovation. Thereby, trust

is grounded in social reputation. Examples of the mobilization of social reputation from this dissertation include the staging and leveraging of expertise and the preoccupation with formalized foresight methods. Engaging hundreds of domain experts in a structured conversation about possible future developments in science, technology and innovation grants the description of pathways and scenarios the credibility to be further considered in the arena. If sufficiently institutionalized, these foresight-policy interactions can have a considerable influence on policymaking. Actors that became visible in this regard include foresight practitioners, state officials, scientists and experts.

While social reputation and value commitments have come to the fore repeatedly in this dissertation, evidence, as another relevant social resource for policy arenas, has hardly played a visible role. The future-oriented framing of foresight practices restricts claims of evidence as there can be no evidence about the future. Instead, the making of evidence as a social resource for innovation policy arenas is practiced through monitoring and evaluation. As integral parts of policy concepts such as mission-oriented innovation policy monitoring and evaluation can test claims against an observable social reality. If an innovation policy measure does not deliver according to what is expected, dynamic adjustments can be discussed in the arena.

The risk of paralyzed directionality arenas

Understanding foresight as a practice to mobilize social resources for directionality arenas allows to resolve the conundrum regarding its role and value in the context of innovation policy. In the context of liberal democracies, this state-driven practice lends legitimacy to the innovation imperative in policy arenas by demonstrating the diverse ways in which innovation can contribute to solving 'grand challenges', the common good or ultimately a 'better world'. This clarification brings two issues to the fore.

Firstly, it uncovers an element of hybris. Throughout the case studies, the formalized and rationalized practice of foresight has shown to contain conflict. For instance, Chapter 4 has shown how foresight methods organize the convergence of expectations and portray potential conflict as alternative scenarios. Foresight's emphasis on pluralization of pathways runs the risk of being misinterpreted as a reality of market-like free choices. While I have argued that there is a social and political shaping of directionality that leads to the pluralization of imagined pathways, all these options would only be equally attainable under the condition of a power vacuum in which the decision to follow one direction rather than another follows a rational motif aimed at increasing the common good. At any moment, the laboriously collected set of

alternative pathways of socio-technical change can be closed down by dynamics in the political-economy. To overcome its hybris, the practice of foresight would need to accentuate how power shapes pathways and directions.

Secondly, and related to this issue, an inflationary use of foresight diminishes the socio-political value of each directionality debate. On the one hand, recurring foresight practices may contribute to the recognition of "irreducible pluralities of possibility" (Stirling, 2024). On the other hand, Chapter 5 has shown that constantly multiplying pathways of future development at different scales and levels entails the risk of strategic divergence that fails the prioritization of specific pathways. Even worse, foresight in the hand of vested interests can be used as a political strategy to devalue and paralyze directionality debates.

Together, the hybris of foresight and the risk of its inflationary or partisan use, bring about an issue for directionality. Foresight practices can be turned against democratizing directionality, when accelerationist strategies confuse or upend directionality debates and shape technopolitics for subverting democratic societies (e.g. the neo-reactionary “dark enlightenment” movement). Concretely speaking, if, under the guise of pluralizing pathways of socio-technical change, we accept the unchallenged pervasion of directionality arenas, through diversionary futures, such as visions of cheap and clean fusion energy, abundant mineral resources from extraplanetary sites and godlike machines of the singularity, we risk the sabotage of democratically orchestrated socio-technical change. In a similar way that the neo-reactionary usage of artificially maintained science controversies has triggered a debate about how STS should articulate and direct critique (Latour, 2004), practices of directionality should become more attentive towards the issue of inflationary and partisan use, before, to rephrase Latour, *futures run out of steam*.

The paralyzation of directionality arenas can be avoided. The practice of foresight provides plenty of opportunities to identify interests, injustices and power games. Instead of veiling antagonisms, it can use them in a productive and responsible way. Analysis of the potential directions of socio-technical change can and should clearly articulate the future as a contested terrain filled with conflicting interests. The appetite for STS can strengthen directionality and contribute to the development of the practice of foresight by articulating concerns.

Contribution to the literature

The interdisciplinary field of study concerned with directionality is still relatively new. Despite conceptual papers trying to compare and integrate different elements

of the discourse (Haddad et al., 2022; Haddad and Bergek, 2023; Andersson and Hellsmark, 2024; Stirling, 2024) the field is characterized by terminological ambiguity. This dissertation has contributed to the discourse by differentiating notions of directionality and related key concepts found in the literature. I hope that this contributes to more clarity and understanding between researchers from the various disciplines involved. While my research does not directly answer the question whether the concept of directionality is nothing but old wine in new bottles, it shows how the discourse on directionality and foresight practices co-produce one another.

Based on this clarification, I developed a conceptual framing of directionality in the making. This framing aims to integrate practice-theoretical approaches into research concerned with policymaking. The practice-oriented analysis of directionality in the making presented it as an unsettled process. This description confirms findings from transition studies and studies of mission-oriented policy emphasizing "goal-oriented modulation" (Kemp et al., 2007), procedural dynamism (Wanzenböck et al., 2020) or reflection, learning, anticipation and experimentation (Lindner et al., 2016).

With its three case studies, this thesis seeks to address the empirical research gap articulated in the literature. It has clearly contributed to understanding how foresight, public engagement and policy practices bring about the initiation, circulation and uptake of directionality debates. With original concept work and illustrative empirical case descriptions, this thesis contributed to the literature on anticipatory practices (Konrad et al., forthcoming), geographies of missions (Uyarra et al., 2025) and foresight. Despite the unique sociocultural, geographic, and political contexts from which the research outcomes stem, the research contributes to a more general perspective on the ambidextrous role of the state in science, technology and innovation.

The image of the Hobbesian two-handed Leviathan has been invoked by scholars from a range of research disciplines to elucidate the ambidextrous practices of the state (Wacquant, 2009; Morgan and Orloff, 2017). A thorough examination of state-driven practices in innovation policy has been conducted, thereby providing a comprehensive understanding of the state's ambidexterity in this regard. On the one hand, it employs coercion and rule-setting as a means of achieving directionality. This phenomenon has, for instance, been examined in research conducted in the fields of standardization and regulation (Blind, 2004, 2012). The other hand of the state, however, has received less scholarly attention. The dissertation project has made a contribution by offering a complementary understanding of this other hand of the state, which pursues directionality through deliberative and discursive

practices. Together, both hands allow innovation policy to be at the same time flexible and able to promote directions.

Furthermore, I hope to have contributed to boundary spanning between the polito-sociological line of research in STS, policy-oriented innovation studies and transition studies. Making this connection is nothing new (Brandão and Bagattolli, 2023; Irwin, 2023). However, by exploring foresight practices of innovation policy, I have tried to provide original insights into the institutional stabilization of socio-technical imaginaries (Jasanoff and Kim, 2015) and the co-production (Jasanoff, 2004) of directionality, policy-oriented practices and research. In this regard, I have shown that policymakers, foresight practitioners and involved publics actively engage with the entanglement of theory, practice and critique concerning innovation policy. In addition to making use of the salient knowledge and models of innovation and transition studies, they embrace tenets of STS. In the context of policy arenas reflexivity and critique are converted into strategic maneuvers and formalized foresight practices that serve the mobilization of social resources for legitimizing directionality debates.

Finally, this dissertation aims to contribute to the development of foresight practices and their reflection. My findings show that foresight is symptomatic for the increasing specialization and rationalization of future-making practices in the political ordering of innovation dynamics in contemporary societies. The case studies have demonstrated how foresight links and constitutes various sets of practices shaping directionality. The concepts developed to analytically capture these practices have implications for foresight. As foresight is persistently engaged in the mobilization of experts and the making of publics for innovation policy, I recommend that this practice be accompanied by research scrutinizing the ontological politics of "enacting the social" (Law and Urry, 2004; Irwin, 2006; Stirling, 2008, 2024). By reflecting on the arenas and actors, their interactions and (loose) coupling as well as the institutional conditions in which foresight takes place, it can prevent the hybris that render directionality debates vulnerable towards interest-driven instrumentalization.

Limitations and future research program

This section reflects the shortcomings encountered during the research and responds to them with a future research program. The doctoral research presented in this thesis has aimed for refining and applying a practice-theoretical approach for the study of directionality as practices through policy-oriented foresight. Instead of clearly delineating foresight as an object of research, I have chosen to conceptually capture it

as a multiplicity of practices, which actively integrate elements of directionality. This has allowed for researching various foresight practices (as explanans) for explaining directionality in the making (as an explanandum).

While I have selected case studies to cover a varied range of practices and policy contexts, including anticipatory practices for Horizon Europe, public engagement for the German High-Tech Strategy and foresight-policy interactions in the Federal German Government, a different selection may have resulted in different findings concerning directionality in the making. Focusing, for instance, on parliamentary technology assessment, monitoring of innovation policy at the regional level or legislative drafting in a ministry would have resulted in different but equally insightful descriptions of directionality in the making. Furthermore, breaking with the Eurocentrism inherent to this thesis by, for instance looking at directionality debates through "multiple modernities" (Eisenstadt, 2002) or under "the global condition" (Appadurai, 2013), would have also resulted in substantially different discussions that Europe could learn from. A key limitation of this dissertation, thus, is the lack of research on other arguably relevant practices and places as well as their reciprocal interactions.

This initial constraint has, at times, posed challenges to the research process. I have argued to turn practice research upside down by following the anticipatory practices that shape innovation policy instead of investigating how policy seeks to shape everyday-life practices (e.g. Shove et al., 2012; Spaargaren et al., 2016). Consequently, the practices studied at the center of this thesis' interest have only little to do with the usual objects of practice research. Foresight practices are not a part of most people's everyday lives, nor are they standard working routines. Rather, they are considered to be exceptional professional practices. At times, this consideration alienated me from the tenets of practice theory and brought me to consider other theories for interpreting my data such as neo-institutionalist accounts (Scott, 2008; Irwin et al., 2021). Arguably, lack of a sound integration of these different theoretical threads remains a limitation of this thesis.

Secondly, the practice approach brought about an empirical challenge. While I have conducted a considerable amount of research as a participant observer and interviewer in the field which allowed me to develop a practical understanding of the practices in directionality arenas, many of the gathered data merely reconstructed practices. I often analyzed notes, memories and articulated perceptions of practices rather than video or audio recordings. Thus, my research design only partially captures the live, in-situ situations in which practices unfolded.

Thirdly, the connection between 'small' practices and 'large' phenomena (Schatzki, 2016) was theoretically clear, but empirically hard to trace. While I have tried to show how chains of action connect, for instance, workshops with policy, many foresight practices also showed to produce no links and simply end. Lacking the authorization of involved policymakers to fill this gap by extending the research design with ethnographic approaches such as shadowing, i.e. observing an individual actor throughout an extended period of time, most of the analysis remained restrained to particular situations, which needed to be interwoven in hindsight.

Beyond these empirical limitations concerning the selection of the case studies and the methodological approach, I also chose to not follow some theoretical discussions that might have been of value. While directionality presupposes that one can be intentional about future innovation, I did not connect my discussions to the wide field of research on intentionality and planning. In addition to 'means-end' planning various planning approaches are available that emphasize the impossibility of governing the future and instead propose intensive monitoring and evaluation. Exploring synergies and differences with planning theories could help generalize observations made in this thesis.

These limitations provide room for continuation of research. A future research program should aim to extend the practice-oriented approach to different case studies. Especially comparative research across world regions could shed light on differentiation and isomorphism of norms, values and culture of directionality. In this regard, three directions seem promising.

Exploring cultures of policy-oriented foresight in directionality debates would necessitate comparative public administration research. Based on existing literature (Kuhlmann and Wollmann, 2014) the investigation of foresight practices could focus on different political systems and administrative cultures. Furthermore, this research could compare directionality debates in other policy domains, especially industrial policy, foreign and security policy. This agenda may continue and refine the exploration of connections with neo-institutionalist perspectives.

In contrast to this, a critical research agenda concerning *directionality as a governmentality* would aim for deconstructing these political systems and administrative cultures. Therefore, it could build on a Foucauldian perspective such as taken in the field of governmentality studies (Bröckling et al., 2012). Researching the genealogy and interplay between discursive knowledge and power may connect to other literature that has engaged with reconstructing past futures (Urry, 2016). Such

research could elaborate on foresight practices, and future-making in more general, as a part of the formation of governing techniques and techniques of the self.

Finally, *perspectives from non-European world regions on directionality* could provide insights into the situated norms, values and cultures for when directions of socio-technical change are debated. Such a research agenda could build on Global South concepts (Maldonado-Mariscal and Hölsgens, 2024) that challenge the hegemony of the Global North's innovation imperative. Moreover, further research in this area could involve the philosophical exploration of various cosmotechnics that preconfigure the differentiation of distinct socio-technical futures (Hui and Lemmens, 2021).

In coming to a close, I would like to return to the quote with which I began this thesis. If we agree that reflecting on the different directions that our societies could take is an essential feature of politics, whether or not intentions and outcomes align, engaged research will need to continue scrutinizing how this is done. Examining the organization of practices around which innovation pathways are imagined, analyzed, explored and appraised is an important research endeavor as it underscores what is at stake in socio-technical change. In light of the geopolitical ruptures that characterize the early months of 2025, researchers have good reason to follow the latest shift in directionality debates. The political rhetorics of technology races and technological sovereignty have escalated into innovation policy debates exploring the acceleration and shaping of innovation for defense industries. In this regard, engaged research should cultivate a sense of responsibility to build ways for diplomacy between science, technology, innovation and states that burgeon beyond the logics of war.

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9. Annex

Table 12 Publication corpus for literature review in Chapter 2

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Table 13 Empirical material for Chapter 4 (excluding documents and notes)

Cited interviews and focus groups (all 2024)	
I1	Senior Policy Officer
I2	Senior Policy Officer
I3	FoD team member
I4	FoD team member
I5	FoD team member
I6	FoD team member
I7	FoD team member
FG	Focus group

Table 14 Empirical material for Chapter 5 (excluding documents and notes)

Cited interviews (all 2022)	
I1	Employee Federal Ministry of Education and Research (BMBF)
I2	Host regional dialogue
I3	Host regional dialogue
I4	Participant regional dialogue
I5	Employee Federal Ministry of Education and Research (BMBF)
I6	Participant regional dialogue
I7	Participant regional dialogue
I8	Participant regional dialogue

Table 15 Empirical material for Chapter 6 (excluding documents and notes)

Cited interviews (all 2021)	
I1	Director-General in a Federal Ministry
I2	Head of Foresight Section
I3	Civil Servant in a Non-Managerial Position
I4	Civil Servant in a Non-Managerial Position, Foresight Capacity Training
I5	Head of Political Planning
I6	Head of Section
I7	Head of Foresight Section
I8	Head of Foresight Think Tank
I9	Director-General in a Federal Ministry

Table 15 Continued

Cited interviews (all 2021)	
I10	Head of Foresight Directorate
I11	Head of Section
I12	Head of Section
I13	Civil Servant in a Non-Managerial Position
I14	Director-General in a Federal Ministry
I15	Civil Servant in a Non-Managerial Position
I16	Secretary of State
I17	Head of Section
I18	Head of Section
I19	Director-General in a Federal Ministry
I20	Director-General in a Federal Ministry
I21	Civil Servant in a Non-Managerial Position
I22	Head of Section
I23	Civil Servant in a Non-Managerial Position
I24	Civil Servant in a Non-Managerial Position
I25	Head of Section
I26	Head of Foresight Directorate
I27	Director-General in a Federal Ministry
I28	Director-General in a Federal Ministry
I29	Civil Servant in a Non-Managerial Position
I30	Civil Servant in a Non-Managerial Position
I31	Civil Servant in a Non-Managerial Position, Foresight Capacity Training

Summary

Society does not stand still. On the contrary, societies are constantly changing. While discourse in the social sciences oscillates between discarding, defending or reinventing the contested notions of modernity and progress, innovation has emerged as the dominant analytical framework and political strategy for shaping change. Thereby, not only technological but also social change is increasingly framed as innovation. This emphasis on innovation raises questions about its trajectories and where they lead.

In research fields such as innovation studies, transition studies and science and technology studies, scientific practice involves assessing, describing and anticipating how socio-technical change evolves. These lines of research examine the conditions of socio-technical change, address the contingency of directions and investigate various innovation trajectories that may emerge in the future and the consequences these may have for society. In interaction with state actors, these knowledge practices have established the epistemic foundation for public policy aimed at promoting innovation activities that pursue specific goals. In other words, policies that provide direction. The forms that directionality takes are the result of debate, appraisal and negotiation.

My thesis starts with the observation that the discourse on directionality at the science-policy interface has given rise to concrete practices that stimulate debates, collective assessment and public appraisal of innovation directions in society. They occupy a spectrum of activities ranging from public engagement to technology assessment, to policy-oriented foresight, all aimed at the social appraisal, exploration and assessment of innovation directions. The objective of this thesis is to examine these practices through empirical case studies in order to gain insights into directionality as a socio-political practice. My research aims to expand the discourse about directionality beyond its origins in evolutionary economics and political science. To do so, I am adopting a sociological perspective inspired by science and technology studies, geography of knowledge and neo-institutionalism. Drawing on and refining a range of analytical concepts, I analyze and weave together the scattered practices found in three qualitative in-depth case studies that form the core of this cumulative thesis.

The first case study examines foresight practices that seek to explore innovation pathways and initiate strategic debates for innovation policymaking at the European Commission. The results of this study show how the practice of foresight can set the scene for a policy arena by synchronizing knowledge, expectations and temporal

demands. The second case sheds light on public engagement that circulates directionality debates between the German Federal Government's innovation policy and regional innovation activities. On the basis of this study, it is demonstrated that the articulation of directionality in regional contexts can pluralize innovation directions, while also producing strategic divergence and loose ends. The third case study scrutinizes foresight-policy interactions within the German Federal Government that aim for organizing uptake of directionality debates. It shows that foresight practices do not readily align with the existing structures and procedures of the ministerial bureaucracy.

My research shows how behind the idea of purposefully directing innovation loom diverse scattered and arena-spanning deliberative processes. These innovation direction debates provide insights into the social co-production and appraisal of innovation in the context of policy. Scrutinizing the formalized practices that bring about these debates, such as foresight, public engagement and their interactions with policy, allows for reconstructing the active integration of spaces, materials, know-how and meanings of directionality—an ever-evolving, arena-spanning process that I call *directionality in the making*. This process constantly articulates issues such as sustainability transitions, or, more recently, rearmament, as problems of innovation. In synthesizing the findings of the empirical case studies, the thesis elaborates on the role of foresight practices for policy arenas and contributes to understanding how legitimacy and reflexivity of innovation policy arrangements are produced.

Samenvatting

De samenleving staat niet stil. Integendeel: samenlevingen veranderen voortdurend. Terwijl het discours in de sociale wetenschappen schommelt tussen afwijzing, verdediging of heruitvinding van de controversiële begrippen moderniteit en vooruitgang, is innovatie naar voren gekomen als het dominante analytische kader en politieke strategie voor het vormgeven van verandering. Niet alleen technische, maar ook sociale veranderingen worden daarbij steeds meer als innovatie gekaderd. Deze nadruk op innovatie roept vragen op over de trajecten ervan en waar deze toe leiden.

In onderzoeksgebieden zoals innovatiestudies, transitiewetenschappen en wetenschaps- en technologiestudies houdt men zich bezig met het beoordelen, beschrijven en voorspellen van sociotechnische veranderingen. Deze onderzoekslijnen onderzoeken de voorwaarden voor socio-technische veranderingen, gaan in op de onzekerheid van richtingen en onderzoeken verschillende innovatietrajecten die in de toekomst kunnen ontstaan en de gevolgen die deze kunnen hebben voor de samenleving. In wisselwerking met het overheidsbeleid hebben deze kennispraktijken de epistemische basis gelegd voor overheidsbeleid dat gericht is op het bevorderen van innovatieactiviteiten die specifieke doelen nastreven. Met andere woorden, beleid dat richting geeft. De vormen die deze directionaliteit aanneemt, zijn het resultaat van debat, beoordeling en onderhandeling.

Mijn proefschrift begint met de observatie dat het discours over directionaliteit op het snijvlak van wetenschap en politiek heeft geleid tot concrete praktijken die debatten, collectieve beoordeling en maatschappelijke evaluatie van innovatierichtingen in de samenleving stimuleren. Deze praktijken omvatten een reeks activiteiten, variërend van publieke betrokkenheid en technologiebeoordeling tot beleidsgerichte toekomstverkenning. Deze activiteiten hebben gemeen dat ze gericht zijn op de maatschappelijke beoordeling, het onderzoek en de evaluatie van innovatierichtingen. Het doel van dit proefschrift is om deze praktijken aan de hand van empirische casestudies te onderzoeken om inzichten te verwerven over directionaliteit als-politieke praktijk. Mijn onderzoek heeft tot doel het discours over directionaliteit uit te breiden tot buiten zijn oorsprong in de evolutionaire economie en de politieke wetenschappen. Daartoe hanteer ik een sociologisch perspectief dat is geïnspireerd door wetenschaps- en technologiestudies, kennisgeografie en neo-institutionalisme. Voortbouwen op en verfijnen van een reeks analytische concepten analyseer en verweef ik de verspreide praktijken die ik aantref in drie kwalitatieve, diepgaande casestudies, die de kern van dit proefschrift vormen.

De eerste studie gaat over toekomstgerichte activiteiten waarmee innovatierichtingen worden verkend en strategische debatten bij de Europese Commissie worden geïnitieerd. De resultaten van dit onderzoek laten zien hoe het toepassen van toekomstverkenning de scène kan zetten voor een beleidsarena door kennis, verwachtingen en tijdelijke eisen op elkaar af te stemmen. De tweede casestudy werpt licht op de publieke betrokkenheid die debatten over innovatierichtingen tussen het innovatiebeleid van de Duitse federale regering en regionale innovatieactiviteiten doet circuleren. Op basis van deze studie wordt aangetoond dat het verwoorden van directionaliteit in regionale contexten innovatierichtingen kan pluraliseren, maar ook strategische divergentie en losse eindjes kan opleveren. De derde studie gaat over interactie tussen toekomstverkenning en beleid binnen de Duitse Bondsregering, die tot doel heeft debatten over directionaliteit te integreren in het regeringsbeleid. Deze studie laat zien dat toekomstgerichte praktijken niet zonder meer aansluiten bij de bestaande structuren en procedures van de ministeriële bureaucratie.

Op basis van mijn onderzoek toon ik aan dat achter het idee van het doelbewust sturen van innovatie veelzijdige, gesitueerde beraadslagingen schuilgaan over de richting van de beoogde innovatie in verschillende arena's. Deze deliberatieve praktijken bieden inzicht in de sociale coproductie en beoordeling van innovatie binnen de context van beleid. Door deze praktijken, zoals toekomstverkenningen en ideeën over publieke betrokkenheid en hun interacties met beleid nauwkeurig te onderzoeken, kan de integratie van ruimtes, materialen, kennis en betekenissen van directionaliteit worden gereconstrueerd. Dit is een voortdurend evoluerend, arena-overschrijdend proces dat ik *directionaliteit in wording* noem. Binnen dit proces worden kwesties zoals duurzaamheidstransities voortdurend verwoord, of, meer recentelijk, herbewapening als innovatieproblemen. In de synthese worden theoretische en praktische implicaties van toekomstverkenningen voor de beleidsarena uitgediept. De inzichten uit dit proefschrift dragen uiteindelijk bij aan een beter begrip van hoe legitimiteit en reflexiviteit van innovatiebeleidsregelingen tot stand komen.

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About the author

Max Priebe was born in Magdeburg, Germany, and currently lives in Berlin. He holds a BA in area studies, sociology and history from the Humboldt University of Berlin and spent one year at the University of California Berkeley, on a UCEAP scholarship. He went on to earn an MA in futures studies from the Free University of Berlin, where he has been involved in teaching ever since. Professionally, he has worked for the United Nations in Southeast Asia as well as with various media outlets and research organizations in Europe and the United States. Since 2020, he has worked at the Fraunhofer Institute for Systems and Innovation Research ISI, where his research interests include mission-oriented policy, innovation governance and foresight.

The state plays a pivotal role in innovation. The question of whether it should utilize its capacity to influence socio-technical change in a particular direction, and the manner in which this can be accomplished, remains a subject of debate. This thesis examines the policy-oriented practices that have come to the fore in the science and politics of directionality.

The research starts with the observation that behind the idea of purposefully directing innovation loom manifold situated deliberations across different arenas. In synthesizing the findings of three empirical case studies, the thesis elaborates on the role of foresight practices in producing legitimacy and reflexivity in innovation policy arrangements. The thesis provides insight into the social co-production and appraisal of innovation within the context of policy. It demonstrates how foresight initiates, circulates and facilitates the uptake of innovation direction debates. This ever-evolving, arena-spanning process, that is *directionality in the making*, constantly articulates issues such as sustainability transitions, or, more recently, rearmament, as problems of innovation.

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