Putting Mission-Oriented Innovation Policies to Work: A case study of the German High-Tech Strategy 2025

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Abstract

Over the last years, numerous national governments as well as the European Union have initiated so-called missions to guide transformation processes and tackle grand challenges, such as climate change, digitalization and an aging society. Previous research on mission-oriented innovation policies (MOIP) has mainly focused on conceptual reflections about mission goals and early stages of the implementation process, but paid little attention to the actual implementation of missions. The aim of the paper is to untangle and reveal the complex processes involved in developing and applying MOIP concepts in political practice (e.g. the role of policy instruments and actors) and provide insights for the advancement of mission approaches. To do so, we focus on the three stages of mission formulation, mission design and mission implementation. The three-fold framework allows delineating different areas of negotiation and contestation, exploring potential bottlenecks when bringing missions into action.

The empirical part of the paper draws on the case of the German High-Tech Strategy 2025 (HTS) which entails twelve missions across different sectors. Even though the German Government officially claims that the current HTS is guided by a mission-driven approach and 12 missions are detailed, the analysis finds considerable problems when it comes to translating this into practice in Germany's political landscape. Our findings call for a conceptual systemic underpinning of MOIP, which contributes to a reduction of complexity and provide better access to understanding the interplay of different instruments and their mix. This way, the discussion paper aims to contribute to a better understanding of the preconditions as well as the main challenges in putting missions to work and to inform the next generation of innovation policies that are currently being issued in Germany and elsewhere.

1 Introduction

Over the last years, numerous national governments as well as the European Union have initiated so-called missions to guide transformation processes and tackle grand challenges, such as climate change, digitalization and an aging society (Larrue 2021). As noted by Janssen et al. (2021), existing research on mission-oriented innovation policies (MOIP) has mainly focused on conceptual reflections about mission goals and early stages of the implementation process, but paid little attention to the actual implementation of missions. At the same time, the implementation of MOIP still remains a challenge for policy-makers (OECD and the Danish Design Center 2022 Lindner et al. 2021). To address this gap, more empirical research is needed to better understand how missions are shaped by political actors as well as societal stakeholders and ultimately turned into policy practice. Identifying challenges along the policy process is an important step towards making mission approaches useful for tackling future challenges.

Therefore, the aim of the paper is to untangle and reveal the complex processes involved in developing and applying MOIP concepts in political practice (e.g. the role of policy instruments and actors) and provide insights for the advancement of mission approaches. To do so, we focus on the three stages of mission formulation, mission design and mission implementation. The three-fold framework allows to delineate different areas of negotiation and contestation, exploring potential bottlenecks when bringing missions into action (Wittmann et al. 2021b).[1]

The empirical part of the paper examines the case of the German High-Tech Strategy 2025 (HTS). First introduced in 2006, the HTS serves as the flagship research and innovation strategy of the German Federal government ever since, bundling all related activities in one comprehensive initiative. The first edition of the HTS focused on pushing 17 key technologies and the underlying research disciplines. Already back then though, the claim was made, that the HTS takes holistic perspective of all departments combined in one framework ("a coordinated innovation policy is more necessary than ever", own translation, based on BMBF 2006, p. 7).

In 2010, the German government undertook a first reorientation, moving away from a narrow focus on technology fields towards an increased emphasis on societal challenges (HTS 2020). Most notably, the willingness to follow a mission-oriented approach was declared for the first time, however without further specifying this new approach and its implications for policies. While the third edition of the HTS mentioned societal actors as important stakeholders, missions to address societal challenges in different domains were only introduced in 2018 with the HTS 2025, the 4th edition of the strategy.

Even though the German government officially claims that the current HTS is guided by a mission-driven approach and 12 missions are detailed, the analysis finds considerable problems when it comes to translating this into practice in Germany's political landscape. The analysis builds on publicly available data as well as information obtained from governmental sources, project execution agencies and independent experts. Further, it draws on the insights from several workshops in which the research team at Fraunhofer ISI was involved. An in-depth analysis of four selected missions aims to contribute to a better understanding of the preconditions as well as the main challenges in putting missions to work and to inform the next generation of innovation policies. In

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[1] While the concept shares similarities with the distinction between strategic coordination, policy co-ordination and policy implementation by Larrue (2021) it puts more emphasis on the different arenas of negotiation and potential translation problems.

Germany, for example, the Federal government is currently drafting a new "future strategy for research and innovation. " (BMBF 2022) The discussion paper highlights several key aspects that require particular attention in this process.

The findings confirm previous research according to which missions are not designed "from scratch", but are embedded in a context of existing policies and instruments (Larrue 2021, p. 9). This has profound implications for MOIP as these will be characterized by different modes of institutional change as well as contestation and negotiation processes amongst actors involved (Wittmann et al. 2021c). This observation points to the necessity that these different steps of policy making (formulation, design, and implementation) are important and distinct features that differ between missions (also due to underlying challenges that they should overcome). These processes demand attention from practitioners and researchers alike. Only then missions can live up to their promise and foster change or even real transformation in the near future. This calls for a conceptual systemic underpinning of MOIP (Wittmann et al. 2022) which contributes to a reduction of complexity and provide a better access to understanding the interplay of different instruments and their mix.

The remainder of the paper is structured as follows: Chapter 2 provides an overview of the main characteristics of MOIP and what sets the new missions apart from previous policy approaches. Further, key challenges that typically complicate the application of MOIP concepts are discussed. Subsequently, section 3 presents the empirical findings. The analysis is structured along the different translation processes identified as relevant for missions, distinguishing between the phases of mission formulation, mission design and mission implementation Finally, in section 4, we discuss main insights gained from the empirical analysis and what they mean for the theory and practice of MOIP.

2 (New) mission-orientation

Since about the early 2000s, a paradigm shift in STI policy strategies has taken place, complementing and in part replacing the rationales of STI policy interventions to address market failures and systemic deficits of innovation systems with the rational of addressing societal challenges. Instead of primarily aiming at economic objectives such as growth and competitiveness, research and innovation should increasingly contribute to solving pressing environmental and societal problems (Daimer et al. 2012; Lindner et al. 2016; Weber et al. 2012). This general idea of directionality in STI policy was broadly taken up by many governments, particularly in the OECD world. However, in many instances STI policy approaches trying to address societal challenges seemed under-conceptualized, since remained unclear which policies were supposed to bring about transformative changes. Further, they appear as overburdened with expectations: How should STI generate the required impact for society at large? Against this background, the concept of MOIP was introduced as a way to operationalise the broad, but unspecific grand societal challenges into manageable packages of problems (Lindner et al. 2021, p. 6).

2.1 The high hopes of MOIP

The concept of missions in the context of STI policy is not new. However, the "old" missions of the 1950s and 1960s, for example, primarily aimed at solving clearly defined technological objectives (Foray et al. 2012). The current, new mission-orientation differs significantly from previous generations, as it is much broader in many respects: the width of (societal) goals, the variety of involved stakeholders, the spectrum of disciplines and sectors involved, as well as the breadth of the required policy mix.

The popularity of Mission-oriented innovation policies (MOIP) was connected to the hope that this approach could help to address pressing societal challenges by defining clear and ambitious goals and comprehensive strategies to reach these goals (Kattel et al. 2018; Mazzucato 2018b). Importantly, the new generation of missions not only differs from its predecessors in terms of its ends, but also with regards to its means, especially the role of STI policy. Similar to traditional missions, also the new MOIP tries to "mobilize science, technology and innovation" (Larrue 2021, p. 15, see also Mazzucato 2018a; Kuittinen et al. 2018b, p. 7). However, the key question is, whether STI policy is expected to achieve the necessary changes alone (cf. Foray et al. 2012; Weber et al. 2014, p. 6).
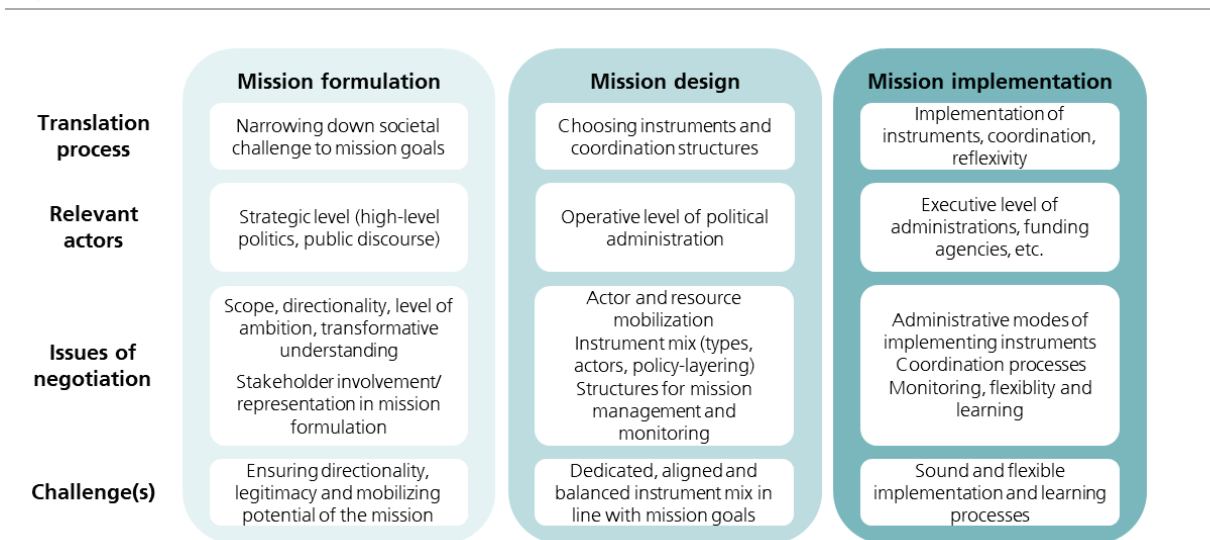
Given the complexity of current societal challenges und the urgent need to realize changes in the way production and consumption in our societies are organized, significant system transformations are needed. These transformations typically reach beyond the established realms of research and innovation policy. Thus, MOIP that aim to contribute to these transformations require clear directionality of science, technology and innovation, coordinated cross-sectoral action and broad actor mobilization (Kuittinen et al. 2018a; Lindner et al. 2021). At the same time, not all missions necessarily have transformative ambitions. In order to capture this empirical heterogeneity of missions Wittmann et al. (2021a) extend the mission typology by (Polt et al. 2019), distinguishing between four ideal types of missions: *Accelerator Type* missions pursue a problem-oriented approach and emphasize in particular the importance of research as a means to initiate the desired changes; the starting point of *Accelerator Type 2* missions tend to be technological developments that have been identified as possible solutions to the underlying problems. The aim is to apply these technological-scientific solutions and accelerate their diffusion; *Transformer type 1* are based on a solution-oriented approach, these missions formulate transformative goals that are to be achieved through the targeted combination of STI policy with other instruments; finally *Transformer type 2* missions are

more problem-oriented than solution-oriented compared to *Transformer type 1*, i.e. the path towards an adequate solution has not yet been identified. At the same time, the transformative claim of this type is more comprehensive, as it includes behavioral changes and also possible redistribution effects. Particularly if missions aim at transformative goals, this might lead to unrealistic expectations, as grand societal challenges hardly can be solved by the means of STI policy alone. This also has profound implications for political ownership and the ability to mobilize relevant stakeholder, including rather classic technology driven *Accelerator* features to comparatively ambitious systemic transformative missions.

2.2 Key processes and steps for workable missions

Missions are complex and dynamic policies associated with multiple challenges when it comes to their realization. While understanding the development of missions as an iterative process involving multiple feedback loops, we propose to analytically distinguish three main process elements characterizing missions as interconnected translation processes, reaching from mission formulation over mission design to mission implementation (Wittmann et al. 2021b). We understand missions as multiple negotiation processes at different levels in varying actor constellations. In effect, the process of goal formulation and its subsequent translation into an implementation strategy is far more than a mere administrative-technical process (Edler et al. 2020). Each of these translation processes requires a different lens and may expose the involved actors to different requirements. Creating awareness for these different roles and their respective challenges can support mission owners and stakeholders to better grasp the processes and disentangle the complexity of MOIP. At the same time, it can help to avoid the distinct challenges at each level that may constitute an obstacle to mission realization. Figure 1 summarizes the key characteristics of the different translation processes, the involved actors and key issues of negotiation.

Figure 1: Missions as multiple translation processes

	Mission formulation	Mission design	Mission implementation
Translation process	Narrowing down societal challenge to mission goals	Choosing instruments and coordination structures	Implementation of instruments, coordination, reflexivity
Relevant actors	Strategic level (high-level politics, public discourse)	Operative level of political administration	Executive level of administrations, funding agencies, etc.
Issues of negotiation	Scope, directionality, level of ambition, transformative understanding; Stakeholder involvement/ representation in mission formulation	Actor and resource mobilization; Instrument mix (types, actors, policy-layering); Structures for mission management and monitoring	Administrative modes of implementing instruments; Coordination processes; Monitoring, flexiblity and learning
Challenge(s)	Ensuring directionality, legitimacy and mobilizing potential of the mission	Dedicated, aligned and balanced instrument mix in line with mission goals	Sound and flexible implementation and learning processes

Source: Figure based on Wittmann et al. (2021b) with some modifications.

Mission formulation

The first translation process is about breaking down a societal challenge into a specific mission. This phase of a mission policy represents the strategic and highly political decision-making process of choosing and 'narrowing down' (Larrue 2021, p. 87) of societal challenges to arrive at dedicated and clearly defined mission goals. While this is carried out mainly at the strategic level of politics,

wider stakeholders can be involved to varying degrees. Depending on the issues at stake, this translation step might be influenced by public debate. Key questions cover the directionality, scope and level of ambition of a mission. Missions can and should be selective in addressing only parts of a societal challenge, define more or less ambitious goals, or reflect different understandings of how to achieve these changes (cf. e.g. Edler et al. 2020). Moreover, it might be contested to what extent and when to involve a wider range of stakeholders into the formulation process. While allowing for broader participation from the very beginning can potentially increase legitimacy and facilitates the inclusion of different actors' perspective, such an approach might entail the risk of strengthening vested interests and veto players, uneven representation of key stakeholders, a watering down of the level of ambition, etc. Pitfalls connected to the mission formulation process are the emergence of incoherent, unrealistic, non-ambitious or unclear goals that could negatively affect the legitimacy, directionality and mobilizing capacity of a mission. In line with this, research has highlighted the importance of the process of mission formulation (Janssen et al. 2020; Wittmann et al. 2020). Deficiencies and shortcomings occurring at this stage can hardly be compensated for in ensuing process steps of MOIP.

Mission design

Building on the choice of mission goals, the second translation takes place when turning the strategic goals into a set of policy instruments and activities that are intended to achieve these aims. Contrary to the previous stage, this involves to a lesser extent the strategic level in public administration but rather operative units in ministries that are responsible for funding programs, as well as public actors. The negotiation concerning the design involves three interrelated aspects. Firstly, MOIP can unleash their potential for transformative change at best if private actors are mobilized alongside public contributions for achieving the mission goals. Secondly, mission design requires the development of an appropriate and coherent instrument mix that is in line with the formulated goals. Missions in this context need to balance between utilizing existing instruments/policies and their purposeful combination with new approaches, while creating sufficient room for experimentation without losing directionality. Finally, mission design requires to clarify responsibilities for the later process of mission implementation and the creation of appropriate means for mission management and monitoring. In sum, the main challenge will be to develop a mission design with a dedicated instrument mix that is closely aligned with the previously formulated goals and prepares the ground for the implementation phase.

Mission implementation

The final translation process refers to the stage of implementation, when actually carrying out, coordination and revising the instruments and activities in the context of a mission. This translation of planned instruments into activities mainly occurs at the operative level of ministries and other mission owners that are responsible for the relevant instruments such as funding agencies. Key questions in this process step relate to the way instruments are implemented, if they are in line with the postulated goals and to the coordination between those instruments. Moreover, an area of negotiation remains the question to what extent insights that are gained during mission implementation actually feed back into the implementation, mission design, and mission goals, balancing experimental approaches with directionality and ensuring a constant alignment with mission goals. In consequence, to unleash the potential impacts of a mission, the implementation is a key prerequisite building upon properly formulated mission goals and a sound mission design.

The three-staged model of missions provides a valuable basis to structure the empirical analysis of the German HTS and identify key challenges in applying MOIP concepts.

3 Case study: The missions of the German High-Tech Strategy

3.1 Mission Types and case selection

Germany has a long history of attempts to employ R&I policies for political and social purposes. As described above, since four legislative terms the HTS has served as Germany's Federal Govern-ments' central STI framework. With the introduction of the latest edition in 2018 (HTS 2025), a mission-oriented approach was explicitly put center stage, defining twelve specific missions to ad-dress key societal challenges across the three broad areas of technology and mobility, sustainability and environment, and health and change (BMBF 2018).

Figure 2: Missions of the HTS 2025

Field of action	Topic	Mission
Societal challenges	Health & care	Combating cancer
		Digitally networking research and healthcare – for intelligent medicine
	Sustainability	Substantially reducing plastic discharged into the environment
		Achieving substantial greenhouse gas neutrality in industry
		Preserving biological diversity
		Creating sustainable circular economies
	Mobility	Developing safe, networked and clean mobility
		Building up battery cell production in Germany
	Urban and rural areas	Ensuring good living and working conditions throughout the country
	Economy & work 4.0:	Shaping technology for the people
Germany's future competencies	The technological base	Putting artificial intelligence into practical application
Open innovation and venture culture	Putting knowledge into effect	Finding new sources for new knowledge

Source: Wittmann et al. (2021a, p.732)

The twelve missions of the HTS 2025 differ significantly in regards to their goals, the means as well as their institutional set up. Applying the mission typology of Wittmann et al. (2021a), more than half of the missions fit the category of *Transformer* missions, whereas one third focus on applying selected technologies as solutions to respective problems, while one mission has a strong research orientation. Notably four missions are associated with the challenges regarding sustainability, whereas two missions are dedicated to improve mobility and health respectively. In the case of the latter, the missions display characteristics of both *Accelerator Types*, which hints at a strong focus on research and technological-scientific solution diffusion. On the other hand, *Transformer Types 1* and *2* are dominant in the field of sustainability which ties in with the more systemic and behavioral changes aspired in this field.

Figure 2: Mission types HTS 2025
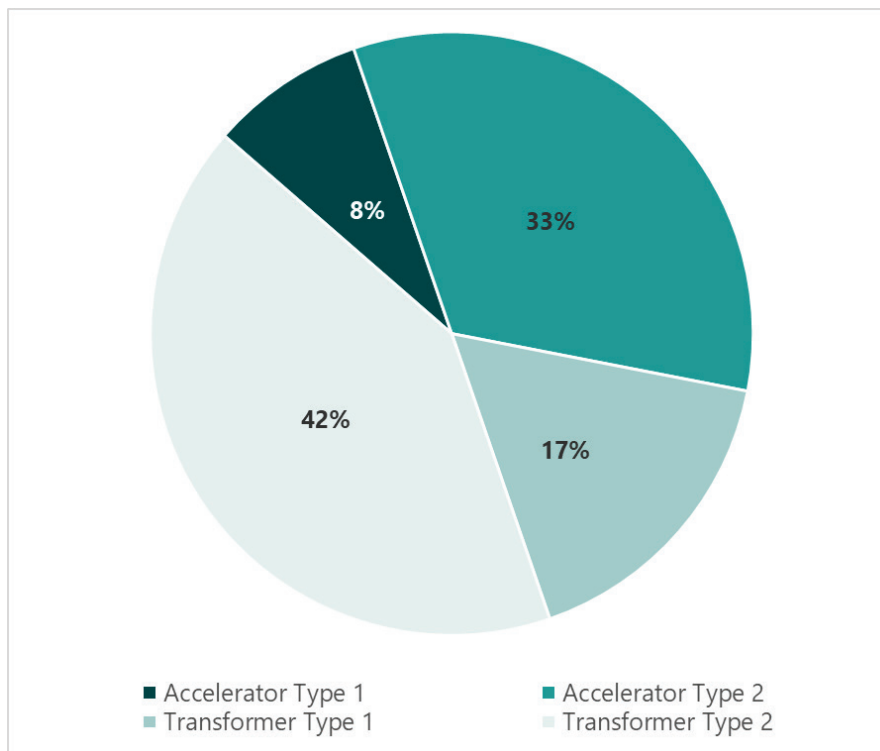
Source: Roth et al. (2021, p. 23)

For the in-depth analysis of the HTS 2025, four cases were selected, each representing one of the four ideal types of the typology introduced above (Wittmann et al. 2021a):

- *Accelerator Type 1 – Combating cancer:* A mission that builds upon the focus on healthcare in previous HTS. Given its emphasis on research activities as a means to combat cancer, it has been classified as an Accelerator Type 1, while exhibiting elements (strengthening of prevention) that aim for behavioral change.
- *Accelerator Type 2 – Achieving substantial greenhouse gas neutrality in industry*: Contributing to address the Grand Challenge of achieving sustainability and mitigating global climate change, the mission strives for bringing new solutions for CO_2 emissions in industry to application. Since the mission does not aim for a comprehensive transformation but focuses on incremental solutions, it can be considered as an Accelerator Type 2 mission:
- *Transformer Type 1 – Creating sustainable circular economies:* A second mission linked to the challenge of sustainability focusing on the re-use of materials and a significant increase of the raw material productivity. It entails considerable transformative elements, by aiming to alter existing structures of the socio-technical system and therefore qualifies as a Transformer Type 1 mission.
- *Transformer Type 2 – Ensuring good living and working conditions throughout the country:* While the question of equal living conditions has been deeply rooted in the German political discourse, a mission that aims to influence factors constituting good living conditions is a novelty in the German HTS 2025. Given its broad approach, the complexity of actor constellations and the anticipated changes to human behavior, it represents a particularly complex mission that falls into the category of a Transformer Type 2.

In this context, however, it is important to keep in mind that missions may contain elements from different approaches, deviating from the ideal types of the mission typology.

3.2 Mission formulation

The goals of the missions of the HTS 2025 mostly relate to grand societal challenges such as sustainability, demographic change, or living conditions where the need for change is in principle broadly supported. While the HTS 2025 covers a variety of topics, the potential interactions and tensions between different missions do not seem to have been sufficiently anticipated. In most of the cases we also observe a thematic continuity with regard to earlier editions of the High-Tech Strategy (BMBF 2006, 2010, 2014), allowing to build on previous activities and structures.

On the other side, also several new topics like artificial intelligence have been introduced, which were not deeply anchored in previous editions of the HTS. These have the potential to broaden the traditionally strong technological focus towards a more problem-oriented perspective, as implied by the concept of MOIP. However, both approaches – the further development of existing strategies and tapping into new fields – come with their specific challenges. Missions relating to existing strategies might get trapped into path-dependencies that impede shifts towards new transformative paths. In consequence, such missions face the risk of not providing more than a reframing of existing policies under the label of mission-orientation. On the other hand, the formulation of missions that address topics which were not at the core of the HTS before entails the risk of duplicating efforts of established sectoral policies. At least some of the missions of the HTS 2025, the added value of a new mission remains rather unclear, because they do not appear to fill valuable niches or develop a strong narrative to ensure broad actor mobilization and visibility. Potentially, this may reduce legitimacy and create conflicts between different actors about responsibilities.

The goals of the missions under study are generally ambitious, aiming to transform or at least change complex socio-technical systems that clearly reach beyond the STI sphere. At the same time, the selected cases have different understandings of the way towards necessary changes. Generally, the investigated missions tend to translate complex societal challenges into rather narrowly defined missions. In many cases, even missions with a transformative understanding are primarily oriented towards classical research and innovation actors, whereas other potentially relevant actors (e.g., regional authorities, consumers, other stakeholders) play a more limited role. At the same time, even for an accelerator mission there is reference to goals related to behavioral change. A case in point is the mission on combating cancer, which is explicitly framed as a research strategy (NDK 2019), but still puts strong emphasis on strengthening prevention measures and altering public perceptions and debates. However, such a broad approach necessarily involves sectoral policies, particularly when touching upon questions of behavioral change and systemic transformation. While many of the HTS missions obviously aim to address societal problems, they still strongly rely on STI policy means. Consequently, effective integration with sectoral policies remains rather patchy.

While exhibiting a certain degree of directionality and intentionality, the cases also indicate considerable room for improvement in these regards. While some of the missions are based on a quantification of mission goals and describe interim goals, in other cases neither goals nor the underlying concepts are clearly specified. The absence of clear definition of goals undermines the mission design and implementation process and creates considerable obstacles for monitoring whether a mission is "on track" or not. In this context, the shift towards societal challenges necessitates an operationalization and definition of multi-dimensional and ambiguous, often nearly intangible concepts such as good quality of life or avoidable cases of cancer. Yet, only if these concepts are specified, it is possible to define mission goals and derive meaningful indicators. Another shortcoming observed was that most missions do not specify interim goals. Given the long-term orientation of most missions, usually exceeding electoral periods, a lack of intermediary steps makes it hard to keep direction.

Moreover, processes of mission formulation mainly occurred within the confines of the HTS, limiting the possibilities to involve stakeholders in the formulation process. The "National Decade against cancer" (NDK) as the main vehicle for the mission on combating cancer illustrates the strengths and weaknesses of a more flexible approach. While "outsourcing" the goal formulation process to the NDK and its partners can be assumed to have generated more commitment among involved stakeholders, the nested character makes it more difficult to clearly identify the goals of the mission which – in practice – are fulfilled through the NDK. Overall, despite a generally high level of legitimacy, the formulation processes of the missions under study did not provide sufficient guidance for the later processes of mission design and actor mobilization. Besides problems in the goal formulation, tensions between the ambition for transformative change and the anticipated way and scope of initiating such changes are evident.

3.3 Mission design

The delineation of relevant instruments contributing to the HTS 2025 missions appears to be poorly defined in most cases or rather an act of subsuming existing and planned policy instruments under a mission headline without a necessary view to the overall composition. So far, varying enumerations of policy instruments associated with individual missions are presented which appear rather arbitrary in the majority of the studied cases. The current practice, however, complicates the assessment with regard to the question to what extent the instrument mix is crafted to suit the individual mission goals as well as the shared targets cutting across missions, because no pathways are available that could provide a clear vision how policy input is intended to achieve impact. To enable an assessment of the current mission design, the research team reconstructed lists of policy instruments, combining different official sources published by the BMBF and additional information provided by ministerial units in charge.

Figure 4: Type of policy instruments for selected missions of the HTS 2025
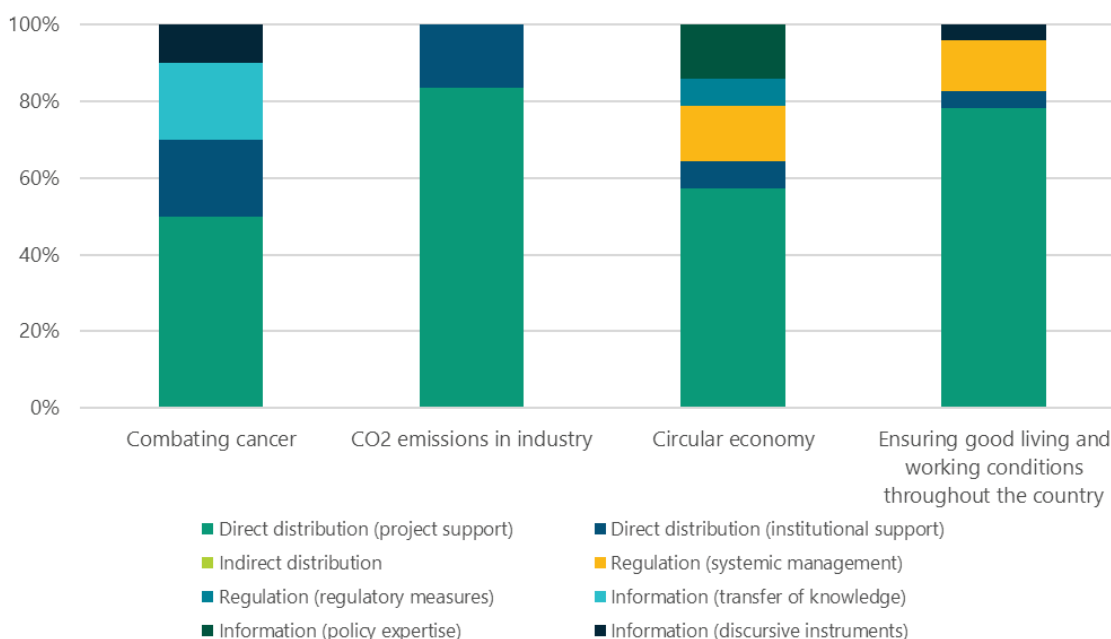
Source: Roth et al. 2021, p.28

The first insight regarding the design is that distributive instruments are obviously the predominant method in the context of MOIP. This finding might not be surprising given the understanding of the HTS 2025 as a research and innovation strategy. It does reveal, however, a stark contrast to the narrative of the whole of government approach throughout the strategy itself. So far, the deliberate inclusion of other types of instruments such as regulation and discursive means[2] as part of a coherent policy mix, carrying substantial potential for achieving the desired transformative and behavioral change, has not been part of the HTS approach. Particularly with a view to Transformer Type missions such as Creating sustainable circular economies (T1) or Ensuring good living conditions (T2), a significantly diversified set of instruments is likely to bring about more impact prospectively. In general, the policy instruments in place display a seemingly high specificity with the potential impact pathways identified by the research, as indicated by the calculation of the Average Instrument Diversity (AID) index (Fernández-i-Marín et al. 2021).[3] From this perspective, the overall specificity of instrument towards goals appears to be relatively similar and high for all missions under study.

This alignment of policy instruments also needs to take into account the effective integration of long-standing instruments with newly introduced ones. Policy layering is a fast way of designing policies and not necessarily problematic since policies are hardly ever built "from scratch"[4] (Larrue 2021). Nevertheless, if efforts and processes to align policy instruments of different strategy generations with the specific goals of a mission are lacking, the materialization of real impact by MOIP is at stake. This highlights the crucial role of evaluation and a culture of flexibility, reflection and experimental learning as well as the determination to learn from mistakes and eventually adjust policy instruments (Lindner et al. 2021, pp. 31–33).

Another key observation derived from the case studies is the rather strong top-down ministerial perspective regarding mission content and resources, with most stakeholders beyond government merely acting as funding beneficiaries. Burden sharing in terms of resource mobilization, capacities and joint ownership across ministries and stakeholders of the socio-technological system concerning the mission appears as rather limited. As can be seen from Figure 5, the only mission being capable of mobilizing inputs from non-federal ministries is the mission on combating cancer, whereas stakeholders in the other mission mainly appear as beneficiaries of support schemes or dialogue partners. The potential to mobilize a wide range of stakeholders and bringing together resources of public and private actors as a main promise of MOIP only appears to manifest itself only to a very limited extent. If government truly wants to deliver on the promise of MOIP to overcome societal challenges, it ought to be the orchestrator of change by actively encouraging a wider range of actors to contribute their resources to gain the necessary momentum.[5] In order to achieve this, a clear and compelling mission narrative and goals are necessary. In consequence, this calls for "processes that effectively contribute to committing stakeholders from the very beginning of a mission" (Wittmann et al. 2021c, p. 77).

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[2] For a more detailed description of policy instrument types please refer to Wittmann et al. (2021c, p. 17) or Hufnagl (2010).

[3] The AID has been proposed for the systemic study and comparison of policy portfolios, exploring to what degree governments address goals repeatedly with the same instrument or rely on specifically-targeted instruments for different problems. Higher levels of AID are generally assumed to reflect a better defined instrument portfolio and corresponds with a higher effectiveness of policies due to a certain level of "instrument customization" and not necessarily one-size-fits-all solutions.

[4] In the case of the four missions, only the mission on combating cancer relies on completely new policy instruments implemented after 2018.

[5] These aspects are also strongly emphasized by the advisory board to the HTS 2025 (Hightech Forum 2021) and by the EFI Commission (Expertenkommission Forschung und Innovation 2021).

Figure 3: Mission inputs by ministries
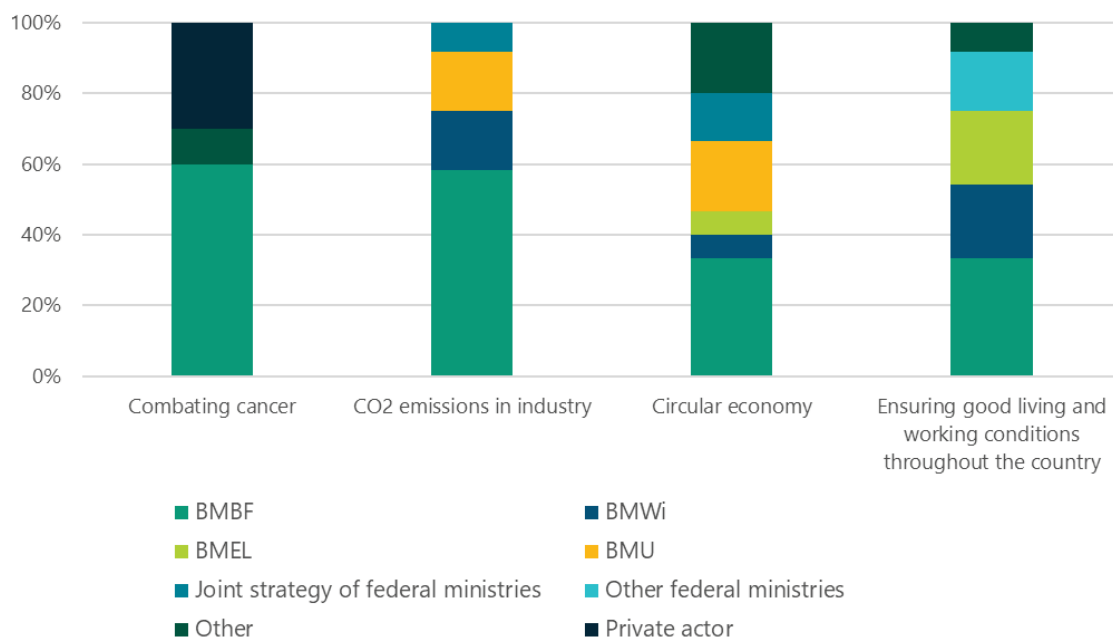
Source: Roth et al. 2021, p. 30[6]

3.4   Mission implementation

For the successful implementation of MOIP, it is necessary to synchronize, integrate, monitor and adapt a broad range of instruments and activities in different policy areas. In the same vein, many missions of the HTS 2025 extend well beyond the STI policy field and, depending on the mission, must be interlinked more or less closely with specialized and sectoral policies. As a general rule, the clearer missions are defined and designed, as well as responsibilities set, the easier is their implementation. As discussed in the previous sections, the goals and instruments of the HTS 2025 are only party specified and mission ownership is not always clear. In consequence, the mission implementation is a particularly challenging part of the HTS 2025.

Following the so-called departmental principle (Ressortprinzip), the primary responsibility for sectoral policies in Germany's political system rests with individual ministries, which enjoy a comparatively high degree of political autonomy. Therefore, it would be illusive, for example, attempting to introduce innovations to the food production system without a clear commitment from and substantial involvement of the Ministry of Food and Agriculture, or endeavouring to transform the mobility system without a strong buy-in from the Ministry of Transport, which both have a pivotal role in the respective policy domains. As a consequence, the implementation of MOIP in the German context first of all means to coordinate the priorities and interests of different ministries. Important prerequisites for interdepartmental coordination processes are laid down in the joint rules of procedure of the federal ministries. In reality, cooperation and coordination are often complicated by tendencies towards interdepartmental competition. Since ministries are generally organized along hierarchical structures, ensuring issue-specific coordination on the working level across different departments (and sometimes even within one ministry) is a challenging task. The implementation of some missions under study is organized through an inter-ministerial coordination group that brings together working level staff from all ministries involved in the mission (typically

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[6]   In the cases of CO2 emissions in industry and Circular economy the data includes policy strategies. Percentages are based on number of instruments not their financial volume.

two to three ministries). However, this is not the case for all missions: For other missions, 'cooperation in delineation' and forms of negative coordination (Braun 2008) can be observed. These rather traditional practises of policy making ultimately result in the division of tasks with separate responsibilities between entities, little productive interactions, and policy fragmentation (Lindner 2012). In those cases in which missions are subject of coordination groups, these meet with varying regularity to discuss and decide on the operational questions related to the mission, but no further insights on tasks, topics and mission dynamics are publicly available. Overall, frequency and intensity of inter-ministerial or trans-ministerial activities appear to be rather low.

An interesting exception in this regard is the mission on combating cancer. This mission is coordinated by a specialized organisational unit within the BMBF, a project group NDK that organizes work on the "decade against cancer", the main vehicle of the mission. This institutional "home base" for the mission management and the shift towards a project-oriented working mode with thematic working groups appears to have contributed to a comparatively close collaboration among involved ministries and stakeholders, thereby providing substantial input to the development of the mission.

4 Implications for policy and governance

Our findings have several implications for a successful formulation, design and implementation of future missions. First and foremost, the review of the German case makes it clear that the formulation of missions is a critical moment of utmost importance for the success of a mission that should be given much more attention. Mission owners should strive for a quantification (or at least qualification) of goals that are to be achieved within a specific time frame, as well as a specification of underlying concepts. As mission goals usually will exceed electoral terms, it is moreover necessary to also define interim goals. Even more important than good goals however is a sound strategic process for the formulation of missions, building on a thorough preparation by the political actors in charge. A coherent and systemic mission formulation process is a basic prerequisite for the mobilization of additional political actors, the inclusion of important stakeholder groups and, last but not least, for public mission communication. Although most missions within the HTS 2025 proclaimed transformative goals, the involvement of stakeholders in the formulation process remained rather limited, with little buy-in beyond the classic R&I actors. Whether the HTS's follow-up strategy, which the German government is currently drafting, will overcome the predecessor's limitations remains to be seen.

Another implication relates to the pivotal moment in every mission when goals are translated into concrete activities by the ministries and other stakeholders involved in implementation. We contend that this step should consider a broad mix of instruments and should be based on systematically derived assumptions about the link between measures, effects and the context. To this end, strategies like the new German "future strategy" should rely on the development of impact pathways, and combine these pathways with an active portfolio management of policy instruments, to maximize the synergies between instruments and ensure that activities are aligned with the mission goals (Wittmann et al. 2022). Missions are more than the sum of individual instruments and only unfold their effects through the interaction of the various contributions of different actors. Therefore, the process of mission design should involve relevant stakeholders in a more comprehensive way than what we observed for the HTS2025, to ensure their commitment and contribution and incorporate their knowledge.

Finally, mission owners need to pay particular attention to ensure an intensive coordination and monitoring throughout the entire mission life-cycle. For successful mission implementation, the analysis demonstrated the importance of constantly gathering relevant information on the progress of the various elements of the mission as well as facilitating the exchange between different actors in order to adapt and further develop the mission, for example, when context conditions change. To fulfill these requirements, sufficient resources and competencies for an active mission management body need to be provided. Without a clear operational management or administrative structures equipped with sufficient resources and capacities, successful mission implementation cannot be expected. Further, we deem it necessary to establish functional monitoring mechanisms that allow to keep track of missions down to the level of individual instruments in a timely, transparent and comprehensive way. This should be complemented by dedicated advisory bodies for individual missions, to ensure the continuous involvement of relevant stakeholders and experts in the ongoing implementation processes.

Implications for governance of missions

Taking MOIP serious entails substantial investments, as the benefits of a mission-oriented approach do not come at zero costs, but require considerable administrative capacities as well as a new way

of planning and implementing public policies. Equipping missions with sufficient human, organizational and financial resources, together with an appropriate institutional design, is a prerequisite for successful missions. Furthermore, we find that in order to ensure high-level political support for the mission-oriented approach, governance structures need to reflect the considerable coordination requirements of the mission-oriented approach, especially in regard to cross-ministerial cooperation. This may imply to move mission responsibility to higher political levels or, alternatively, to delegate the responsibility for missions to one or several agencies. Further, much more emphasis needs to be directed at inclusive processes that strengthen the ownership of relevant stakeholders in the different phases of a mission in order to mobilize resources from both private and public actors.

In general, MOIP actively need to face public debates and engage in dialogue with the wider public. This makes it also necessary for mission owners and involved actors to actively communicate the aims, the instruments and the progress of the missions. Mobilizing for missions requires a convincing narrative, clearly formulated goals and an aligned instrument mix. Therefore, we consider the establishment of sound strategic processes along the different phases of missions as a key prerequisite for bringing missions into realization. Attempts to simply re-label existing approaches without effectively altering the approach to policy-making will result in shallow missions that primarily exist on paper and are unlikely to reap the promised benefits.

Missions create the most added value when they are able to bundle existing efforts and ensure a close alignment of activities at different levels across different fields and mobilize diverse actors for a clearly defined shared goal. Missions should strive for an integrated instrument mix of both existing and new policies, bringing together STI with sectoral policies – obviously a core challenge that has been debated by academia as well as policy practitioners ever since MOIP have been established: missions should not be approached from finding niches aside established policies, but instead aim for a more integrated approach. Particularly challenging but also rewarding are efforts to generate synergies between missions by means of a dedicated meta-governance of missions. A more coherent pooling of missions along thematic focal points and the definition of clear and overarching goals would open up the possibility of exploiting synergies between individual missions in a more targeted manner than has been the case to date.

Finally, to improve the adaptability and flexibility of MOIP, institutional arrangements and organizational cultures should become a major focus. At an institutional level, this implies to create governance structures and a learning culture that is capable of absorbing the feedback from mission implementation and individual programs and feed them back into the advancement of a mission, such as, for example, the question how to draw lessons from experimental policies, such as real laboratories. Useful for this purpose could be interdisciplinary advisory boards for each mission, composed of independent experts and stakeholders. At a more cognitive level, the shift towards MOIP requires a reflexive approach that also affects the administrative, organizational and political culture. The ability to learn from experiences, whether pleasant or not, strongly builds on a culture accepting risk and possible failure. An honest and transparent stock-taking of what is working and what not is extremely useful for the further development of the mission. In policy contexts characterized by complexity and uncertainty, high levels of adaptability and strategic reflexivity are of key importance.

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