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Lessons for Future Mission-oriented Innovation Policies

Final report of the Scientific Support Action to the German High-Tech Strategy 2025 - volume 1

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Background

The High-Tech Strategy 2025 (HTS 2025) is the central science, technology and inno-vation (STI) strategy of Germany's federal government. Commissioned by the Federal Ministry of Education and Research (BMBF), the Fraunhofer Institute for Systems and Innovation Research ISI provides scientific support to the HTS 2025 and develops rec-ommendations for the future of mission-orientation in context of the HTS. The present publication (Final Report 1) offers several key insights into the strengths, weaknesses and potential advancements of the HTS 2025, but also provides an overview of the **les-sons learned** for future mission-oriented innovation policies (MOIP) more generally. A complementary publication (Final Report 2) develops a novel toolbox approach to sup-port mission owners in the implementation process of MOIP and simultaneously provides the foundation for impact assessment.

Already in 2010, the German federal government announced a reorientation of its STI strategy, shifting from a primary focus on fostering key technologies to a **challenge-oriented approach**. With the introduction of the latest edition in 2018 (HTS 2025), a mission-oriented approach was explicitly put center stage by defining twelve specific missions to address key societal challenges, such as environmental pollution, climate and demographic change. At the same time, the design and implementation of MOIP are considerably more demanding than traditional STI policies.

To examine the way MOIPs are put into practice by the HTS 2025, the research team conducted two consecutive in-depth analyses of four selected missions of the HTS 2025:

- Combating cancer
- Achieving substantial greenhouse gas neutrality in industry
- Creating sustainable circular economies
- Ensuring good living and working conditions throughout the country.

The missions were identified as representative examples of different ideal types of mis-sions, based on a novel typology that was developed in the context of this project[1]. The analysis draws on insights from a series of expert interviews, an extensive analysis of official documents, as well as several workshops with policy-makers and researchers from Germany and other countries, including the United Kingdom, Japan and the Neth-erlands. This report summarizes the key insights from these analyses and provides pol-icy recommendations.

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[1]   http://publica.fraunhofer.de/dokumente/N-586291.html

Key findings

Based on the new mission typology, the analysis shows that the HTS 2025 comprises a broad **diversity of missions**, from rather classic technology driven missions to comparatively ambitious systemic transformative missions. Overall, the missions under study reveal a high level of legitimacy, in most cases refining topics already addressed in earlier editions of the HTS. Missions usually relate to grand societal challenges such as sustainability, demographic change, or living conditions where the need for change is in principle broadly supported. Notably four missions are associated with the challenges regarding sustainability, whereas two missions are dedicated to improve mobility and health respectively. 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 when the associated policies where crafted.

Most **goals of the missions** under study are ambitious, aiming to transform or at least change complex socio-technical systems. This includes the STI sphere, but clearly reaches beyond it. However, a few missions also display rather vague goals which makes it challenging to track whether and how complex societal challenges have been translated into concrete MOIP at all. Drawing on a comprehensive system analysis, we show that in many cases even missions with transformative ambitions and a cross-sectoral understanding of the underlying challenge to solve, primarily entail policies oriented towards typical research and innovation actors. This narrow interpretation of mission goals most likely falls short of actively addressing other potentially relevant actors (e.g., regional authorities, consumers, other stakeholders). Further, also the rather patchy integration with sectoral policies so far offers room for improvement. While some of the missions exhibit a certain degree of directionality and intentionality, including quantified mission goals and interim milestones, in other cases neither goals nor the underlying concepts are clearly specified. As a consequence, 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 resulted in a rather limited appeal for actor mobilization.

To enable an **assessment of the design** of the HTS 2025 missions, the research team compiled an inventory of all mission-related policy instruments, as mentioned in different official sources published by the BMBF and additional information provided by ministerial units in charge. In general, the policy instruments in place have a high specificity with the mission goals, with a strong emphasis on distributive approaches. However, the analysis also shows that the delineation of relevant instruments contributing to HTS missions (together) appears to have been poorly defined, in several cases rather subsuming al-

ready existing or planned policy instruments under a mission headline without a neces-sary view to the overall composition. 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. Thereby, most of the missions under study do not fulfill the promise to increase leverage by mobilizing both private and public actors to achieve joint owner- and leadership of the missions.

Mainly due to the so-called departmental principle (Ressortprinzip), 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 pro-cesses are laid down in the joint rules of procedure of the federal ministries. Cooperation and coordination are often complicated by interdepartmental competition. There was little evidence that missions facilitate positive exchange between different ministries going beyond a delineation of responsibilities and negative coordination. Overall, frequency and intensity of inter-ministerial or trans-ministerial activities appear to be rather low. During the course of the scientific support action we could, however, observe a growing awareness and willingness to improve this, also due to the fact that the characteristics of MOIP are increasingly better understood by policy makers on strategic and executive levels.

Advancing mission formulation, design and implementation

Based on the insights from the HTS 2025, the report presents several **recommenda-tions** for a successful formulation, design and implementation of future missions. First and foremost, the review of the German case makes clear that the formulation of mis-sions is a critical moment of utmost importance for the success of a mission that should be given much more attention in the future. Above all, this requires 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. Further, mission formulation 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 under-lying concepts. As mission goals usually will exceed electoral terms, it is moreover nec-essary to also define interim goals.

Another recommendation 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 be based on systematically derived assumptions about the link between measures, effects and the context. To this end, **impact pathways** should be developed, together with an **active portfolio management of the instruments** of the mission, to ensure that activities are aligned with the mission goals. 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 all relevant stakeholders, to ensure their commitment and contribution and incorporate their knowledge.

Finally, mission owners need to pay special 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.

General recommendations

The report concludes with several general recommendations for future MOIP. The first relates to the **governance structures 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.

In addition, the report concludes that missions create the most added value when they are able to bundle existing efforts across different fields and **mobilize diverse actors for a shared goal**. Thereby, missions strive for an integrated instrument mix of both existing and new policies, bringing together STI with sectoral policies. Therefore, 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.

1　　Background: Scientific support action for the German High-Tech Strategy 2025

Over the last years, numerous governments, particularly in the OECD world, as well as the European Union have initiated so-called missions as part of their research and innovation policy strategies. Mission-oriented innovation policies (MOIP) have the aim to reach ambitious and clearly defined goals that address pressing societal challenges. Given the complexity of these challenges und the urgent need to realize changes in the way production and consumption in our societies are organized, significant system transformations are needed which typically reach beyond the established realms of research and innovation policy. Thus, MOIP aiming to contribute to these transformations require clear directionality of science, technology and innovation, coordinated cross-sectoral action and broad actor mobilization. In important ways, these requirements call for substantial changes in how policies are designed and implemented.

Already in 2010, the German federal government announced a reorientation of its central science, technology and innovation (STI) strategy, the High-Tech Strategy (HTS), shifting from a primary focus on fostering key technologies to a challenge-oriented approach. With the introduction of the latest edition in 2018, a mission-oriented approach was explicitly put center stage by defining twelve specific missions to address key societal challenges, such as environmental pollution, climate and demographic change. In many ways, these twelve missions display a rather experimental character with regard to their formulation and implementation, offering valuable opportunities to identify starting points for the further improvement of this policy approach for the next generation of MOIP.

The emphasis on directionality in STI policy is accompanied with high hopes that innovative ideas, processes and products will not only address but also solve many of these problems. At the same time, the design and implementation of MOIP are considerably more demanding than traditional STI policies. As already stated in a previous report,

> *"(t)his re-orientation towards societal goals requires conceptualizing policies in a broader and crosscutting way, understanding the potential impacts of these policies in different sectors and domains, and finally, developing new institutional arrangements that integrate a wide range of actor groups and stakeholders. In many ways, this new mission-orientation challenges established governance mechanisms and calls for new approaches for designing and implementing innovation policy." (Wittmann et al. 2020b, p. 1).*

As these approaches always need to take into account the specific socio-political and socio-technical contexts, there exists no one-size-fits-all approach for the successful re-

alization of MOIP. Rather, mission-oriented strategies need to be developed and constantly adapted, based on past experiences, international good practices, and of course the challenges societies face.

Since 2019, the Fraunhofer Institute for Systems and Innovation Research ISI provides scientific support to the HTS 2025 and develops recommendations for future policies on behalf of the German federal government. The project has resulted in two final reports, each with a different topical focus. The present report (Final Report Vol. 1) presents the main insights from the empirical analyses of the HTS 2025 and suggests policy options to advance mission-oriented policies in Germany and beyond. The second report (Final Report Vol. 2, Wittmann et al. 2021b) develops a framework for formative evaluation and impact assessment of MOIP.

This report is structured as follows: In the remainder of this introduction, a brief overview of the scientific support action, project-related outputs and activities is provided. The subsequent chapter presents key conceptual insights for the study of MOIP, their specific challenges and requirements. Section 3 summarizes the key empirical results from the analyses of the HTS 2025, focusing on the insights generated in the in-depth case studies of four selected missions. Building on these insights, section 4 outlines policy recommendations for the future design and implementation of MOIP. A summary of the report's findings is provided in the final section.

1.1   Aims of the scientific support action

From April 2019 to December 2021, a research team at Fraunhofer ISI investigated the concepts and practices of MOIP, focusing on the case of the German High-Tech Strategy 2025. This scientific support action was commissioned by the Federal Ministry of Education and Research (BMBF) and carried out independently by Fraunhofer ISI. Formally, the project was part of the accompanying support and coordination infrastructure of the High-Tech Forum, the main STI policy advisory body of the German government for the implementation of the HTS 2025.[2]

The project had two main objectives, as illustrated in figure 1. First, the scientific support action developed recommendations for the process of mission design, formulation and implementation. To this end, it particularly drew on two consecutive in-depth analyses of four selected missions of the HTS 2025 (Wittmann et al. 2020b; Wittmann et al. 2021d): Combating cancer, Achieving substantial greenhouse gas neutrality in industry, Creating sustainable circular economies, Ensuring good living and working conditions throughout

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2   https://www.hightech-forum.de/

the country. The missions were identified as representative examples of different ideal types of missions, based on a novel typology that was developed in the context of this project (Wittmann et al. 2021a). Part of the project's remit was to offer scientific support to the ministerial units in charge of implementing the HTS 2025 missions.

The second aim of the scientific support action was to develop a novel framework to assess the impact of mission-oriented innovation policies. This framework is published in parallel to this report as the Final Report Vol. 2 (Wittmann et al. 2021b). As preparatory research towards this framework, the team developed an overview of the current status of research on impact assessment of mission-oriented and transformative policy (Wittmann et al. 2021e).

Figure 1: Overview of scientific support action to the German High-Tech Strategy 2025

Source: https://www.isi.fraunhofer.de/en/competence-center/politik-gesellschaft/projekte/htf2025.html
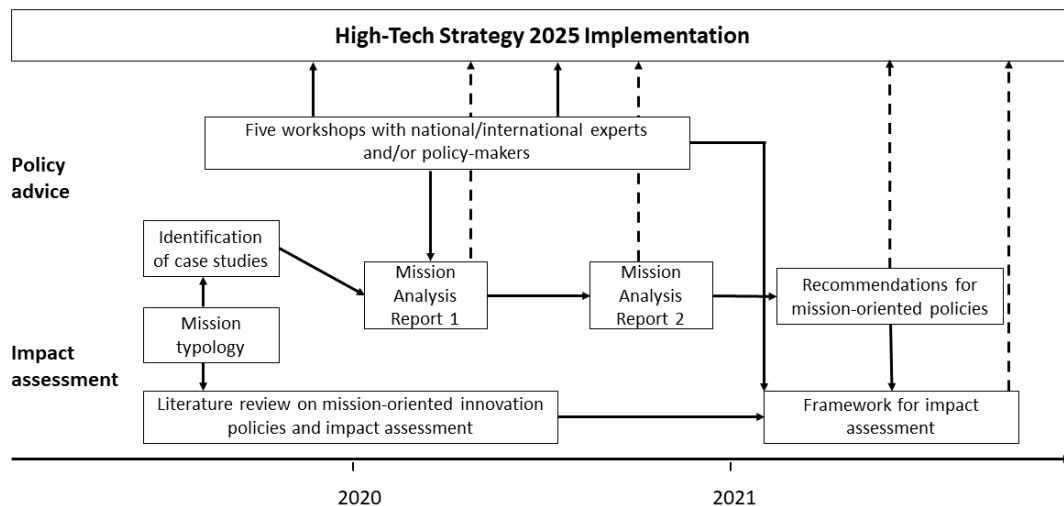
1.2 Activities and outputs

The findings presented in this report build on the analysis of publicly available data as well as information obtained from governmental sources, project execution agencies and independent experts. Further, the report draws on the insights from several workshops in which the research team at Fraunhofer ISI was involved as part of its scientific support mandate to the HTS 2025:

- 5 international expert workshops with policy-makers and experts from the United Kingdom, the Netherlands, Japan, Germany and the OECD on current challenges of MOIP in different national settings,

- 1 high-level symposium on the state and future of MOIP, organized by the High-Tech Forum,

- 4 workshops with representatives of the BMBF focusing on the implementation of individual missions within the HTS 2025,

- 5 scientific conferences, organized by the European Forum for Studies of Policies for Research and Innovation (Eu-SRPRI), the Transformative Innovation Policy Consortium (TIPC), and the Sustainability Transitions Research Network (STRN),

- 6 mapping workshops with Fraunhofer ISI experts on selected mission topics (Health, regional development, circular economy, CO_2 emissions) to analyze mission-specific socio-technical systems and impact pathways,

- 3 method workshops with Fraunhofer ISI experts on impact assessment and indicator development.

These activities informed a series of publications, including several workshop reports, peer-reviewed academic publications and a number of technical reports. A full list of project publications can be found in the appendix:

- Wittmann, F.; Hufnagl, M.; Lindner, R.; Roth, F.; Edler, J. (2020): Developing a Typology for Mission-Oriented Innovation Policies (Fraunhofer ISI Discussion Papers Innovation Systems and Policy Analysis No. 64). Karlsruhe: Fraunhofer ISI.

- Wittmann, F.; Roth, F.; Hufnagl, M., with contributions by Lindner, R.; Yorulmaz, M.; Bratan, T.; Arens, M.; Rohde, C.; Ostertag, K.; Pfaff, M.; Stahlecker, T.; Zenker, A.; Steinebrunner, D. (2020): First Mission Analysis Report of the Scientific Support Action to the German Hightech Strategy 2025 - Setting the stage: Positioning the missions in the socio-technical system. Karlsruhe: Fraunhofer ISI.

- Wittmann, Florian; Yorulmaz, Merve; Hufnagl, Miriam (2021): Impact Assessment of Mission-Oriented Policies. Challenges and overview of selected existing approaches. Karlsruhe: Fraunhofer ISI.

- Wittmann, F.; Roth, F.;Hufnagl, M.; Yorulmaz, M.; Lindner, R. with contributions by Bratan, T.; Arens, M.; Rohde, C.; Ostertag, K.; Pfaff, M.; Stahlecker, T.; Zenker, A. (2021): Second Mission Analysis Report of the Scientific Support Action to the German Hightech Strategy 2025. Zooming in: Translating missions into policy instruments. Karlsruhe: Fraunhofer ISI.

- Roth, F.; Lindner, R.; Hufnagl, M.; Wittmann, W.; Yorulmaz, M. (2021): Lessons for Future Mission-oriented Innovation Policies. Final report of the Scientific Support Action to the German High-Tech Strategy 2025 - volume 1, Karlsruhe: Fraunhofer ISI.

- Wittmann, F.; Hufnagl, M.; Roth, F.; Lindner, R.; Kroll, H. (2021): A Framework for Formative Evaluation and Impact Assessment of Mission-oriented Innovations Policies. Final report of the Scientific Support Action to the German High-Tech Strategy 2025 - volume 2, Karlsruhe: Fraunhofer ISI.

- Lindner, R.; Hufnagl, M.; Roth, F.; Wittmann, F.; Yorulmaz, M. (2021): Erkenntnisse aus der Begleitforschung zur Hightech-Strategie 2025. Kurzbericht: Empfehlungen für eine künftige Umsetzung missionsorientierter Politik. Karlsruhe: Fraunhofer ISI.

- Hufnagl, M.; Wittmann, F.; Roth, F.; Yorulmaz; Lindner, R. (2021): Erkenntnisse aus der Begleitforschung zur Hightech-Strategie 2025. Kurzbericht: Entwurf eines Wirkungsmesskonzepts für Missionsorientierte Innovationspolitik. Karlsruhe: Fraunhofer ISI.

2   Conceptualizing MOIP

The impressive career of mission-oriented approaches has to be understood in the context of the broader developments of STI policy. 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 directionality in STI policy was broadly taken up by many governments, particularly in the OECD world. However, in many ways the STI policy approaches trying to address societal challenges fell short of generating the required impact for transformative changes. 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). Figure 2 provides an overview of the three most influential STI policy paradigms since the late 1940s.

Figure 2:   Different paradigms of STI-policies
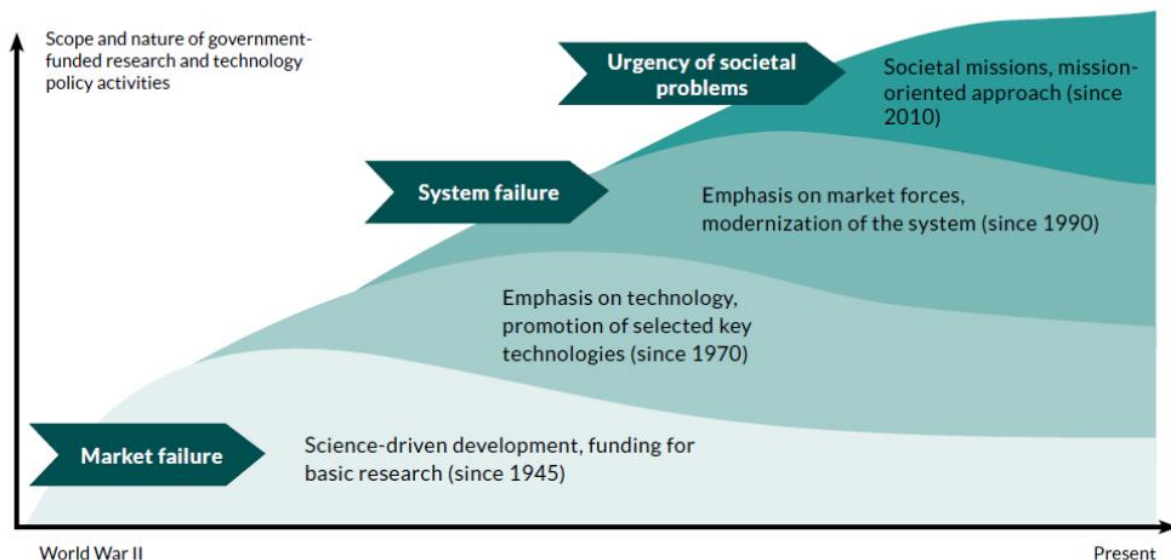
Source: Figure from Breitinger et al. (2021, p. 25) based on Daimer et al. 2012; Gassler et al. (2006)

The concept of missions in the context of STI policy is not new. However, the "old" missions of the 1950s and 1960s, for example, were primarily aiming to solve 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 goals, the variety of involved stakeholders, the spectrum of disciplines and sectors involved, as well as the breadth of the required policy mix.

Despite (or because of) its growing popularity, so far, no generally accepted definition of MOIP exists. Table 1 provides an overview of some of the most common definitions that can be found in the literature (Kuittinen et al. 2018, pp. 2–3). Similar to this diversity of definitions, the empirical reality of MOIP is characterized by a considerable range of different understandings and approaches as well (Kuittinen et al. 2018; Polt et al. 2019; Wittmann et al. 2021a).

Table 1:   Definitions of MOIP

"[W]e view MIP as a directional policy that starts from the perspective of a societal problem, and focuses on the formulation and implementation of a goal-oriented strategy by acknowledging the degree of wickedness of the underlying challenge, and the active role of policy in ensuring coordinated action and legitimacy of both problems and innovative solutions across multiple actors." (Wanzenböck et al. 2020, p. 476).
"A mission-oriented innovation policy is a co-ordinated package of policy and regulatory measures tailored specifically to mobilize science, technology and innovation in order to address well-defined objectives related to a societal challenge, in a defined timeframe. These measures possibly span different stages of the innovation cycle from research to demonstration and market deployment, mix supply-push and demand-pull instruments, and cut across various policy fields, sectors and disciplines." (Larrue 2021, p. 15).
"Mission-oriented R&I initiatives, be they private or public, typically are ambitious, exploratory and ground-breaking in nature, often cross-disciplinary, targeting a concrete problem/challenge, with a large impact and a well-defined timeframe. More specifically, they have a clearly defined (societal or technological) goal with preferably qualified and/or quantified targets and progress monitored along predefined milestones. Directionality and intentionality of these initiatives is what differentiate them from other types of initiatives, such as systemic or challenge-oriented policies." (Kuittinen et al. 2018, p. 7).
"We define a societal challenge-based mission as 'an urgent strategic goal that requires transformative systems change directed towards overcoming a wicked societal problem."(Hekkert et al. 2020, p. 77).

"We understand mission-oriented innovation policy as a cross-sectoral and cross-policy approach to achieving ambitious and clearly formulated goals via the generation and application of knowledge and innovation that address pressing societal challenges. The goals must be clearly defined as well as being measurable and verifiable, and they must be implemented within a clearly defined timeframe. Only when missions aim at behavioral and structural change, in addition to generating knowledge and innovation, do they contribute to comprehensive system transformations. Practices, actors and institutions must all be reconfigured as a result of the transformations" (Lindner et al. 2021, p. 7).

Source: Own compilation

2.1   Ambitions of missions

The strong emphasis on transformative change connects the concept of MOIP to the extensive literature on system transitions. At the same time, MOIP are different in several aspects. Key differences include the agency of involved actor, the policy-driven character of MOIP, and the time-frame of system change (cf. also Arnold et al. 2019, p. 17 for a more comprehensive overview).

A key question remains to what extent missions are intended to be transformative. Kuittinen et al. (2018, pp. 12–13), for example, distinguish between more narrowly and broader defined missions, whereby the latter "aim at (or implying) the transformation of systems to address wicked (often societal) challenges". In line with this, research has developed a number of "missions with adjectives" like "societal challenge-based mission" (Hekkert et al. 2020, p. 77) or "ambitious MOIP" (Lindner et al. 2021) to highlight the importance of transformative change. A somewhat different interpretation may be found in Wittmann et al. (2021a) pointing to the fact that it might be not necessarily the goals that differ, but the different understandings on how to achieve the desired changes. Whereas some missions emphasize a science-driven understanding of change that places STI policy at the center, other missions postulate a broader understanding of change that is related to a variety of drivers.

2.2   Scope of missions

The new generation of missions not only differs from its predecessors in terms of its ends, but also with regards to its means. The main question affects the different 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 2018; Kuittinen et al. 2018, 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). 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. Reducing the level ambition, however, might put the legitimacy of missions under pressure. Alternatively, the integration of STI policy with other policy fields can be complicated, as it requires to negotiate the relative position of STI policies. Whereas for some problems and mission STI may be considered as a key driver, in other cases it may only act as one contribution among others. This has profound implications for political ownership and the ability to mobilize relevant stakeholders, but also triggers question to what extent MOIP can be then analyzed from a STI perspective alone.

2.3   Key requirements of MOIP

The emergence of the paradigm of new mission-orientation becomes manifest at different levels. On the one hand, it strengthens a re-orientation at the strategic level of goals shifting towards transformative change and emphasizing directionality. However, MOIP is more than formulating goals in a new ways (Janssen et al. 2021). The concept of mission-orientation requires a new approach to policy-making itself, opening up for the involvement of different stakeholder groups and challenging established routines and processes(Lindner et al. 2021). In consequence, the new mission orientation is accompanied with far-reaching requirements that are caused by two levels of transformativity – the transformation of the socio-technical systems and the transformation of policy-making structures and practices. Previous research points to several key challenges associated with MOIP:

Directionality: A key characteristic of mission policy is the introduction of directionality. As such, MOIP require the definition of clear but ambitious goals (Mazzucato 2018, 2019) to provide a clear direction of desirable developments. As missions' impact may materialize only in the long run and is linked to systemic changes, this requires a clear specification and definition of the goals to be achieved taking into consideration application and realization. In consequence, this requires involved actors committing to clear goals, avoiding vague formulations and wishful thinking.

Politicization: The shift towards directionality entails a higher degree of politicization of MOIP (Boon et al. 2018), requiring involved actors to actively join public discourse on the priorities to be pursued. MOIP do not necessarily only focus on promoting certain solutions, but may also emphasize the need to phase out undesirable solutions, thus producing losers that might oppose the desired changes. Due to their more direct interventions in society and economy, MOIP require higher levels of legitimacy, reaching beyond traditional rationales of STI policy intervention.

Multi-disciplinarily: Mission that aim for transformative change require structures that cut across disciplinary and sectoral boundaries. While in many cases STI policy may contribute to solving pressing societal issues, MOIP typically require to combine STI policy with other policies in order to achieve the goals. Such a comprehensive approach may run counter to established working modes and requires an integration of different stakeholders and traditions into a coherent policy. In consequence, MOIP is not only the responsibility of actors in the field of STI, but makes it necessary to integrate other sectoral actors to achieve a comprehensive approach.

Actor integration: Transformation processes necessitate the integration of different strands of activity of different actors. On the one hand, this requires intense coordination and cooperation among public actors at different levels, as competencies are often shared between different ministries and administrative levels. Therefore, missions need to overcome the silo-structure that characterizes many political problems, bringing together different public actors to jointly address a problem by bringing in own expertise and resources. On the other hand, MOIP are not limited to public actors, but require a broad mobilization of all relevant stakeholders, ensuring their commitment and substantial contributions to the mission. Many societal problems cannot be addressed without the participation of private actors. MOIP therefore should not rely on a top-down mode of policy-making, but should seek to actively involve stakeholders in all steps of the policy process.

Instrument diversity: The broad orientation of missions aiming to stimulate changes in different areas does not only require a broad actor involvement, but also a diversified set of policy instruments supporting this change. In consequence, classical STI policy instruments need to be complemented with other types of instruments focusing on behavioral change, demand stimulation, regulation etc. A key challenge in this regard will not only be the identification of appropriate instruments, but also the alignment of existing policies and the continuous development of new instruments addressing gaps in the instrument mix.

Flexibility: Even when starting off from a clearly defined mission goal, missions are likely to evolve over time. Despite the need for a sound strategic process for defining mission goals and developing an appropriate instrument mix, missions need to take up current dynamics and respond flexibly to changing contexts and mission progress. Thus, balancing directionality with flexibility remains a challenge for mission implementation. Instead of a static, unresponsive perspective, constant monitoring and the strengthening of a culture that is receptive for learning and experimentation are essential.

Management and monitoring: Given their complexity at multiple levels, missions are highly demanding in their implementation, requiring considerable resources for implementation and mission management, and possible even institutional adjustments. At the same time, monitoring the mission progress and assessing the impacts of missions remains a challenge in itself (Wittmann et al. 2021e). The second volume of the final report proposes a process-oriented approach that combines formative and summative elements in a toolbox to support mission development, implementation and impact assessment (Wittmann et al. 2021b).

In the following, we propose a conceptual framework that helps to disentangle, structure and address the multitude of challenges involved in MOIP.

2.4   Reducing complexity: Missions as multiple translations

Missions are complex and dynamic policies associated with multiple challenges when it comes to their realization (see section 3.2). While understanding the development of missions as an iterative process involving multiple feedback loops, we propose to analytically distinguish three main process elements characterizing the realization of missions as multiple and interconnected translation processes, reaching from mission formulation over mission design to mission implementation (Wittmann et al. 2021c). We understand missions as multiple negotiation processes taking place 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.

We consider this perspective to be highly relevant for MOIP. First, missions rarely emerge from scratch but more often than not are embedded in a field of previously existing policies (Larrue 2021). As a result, the creation of a mission is likely to take up existing strategies and will at least partly rely on existing instruments, opening considerable room for interpretation and discussion on how these existing structures can be aligned with MOIP. Second, aiming for transformative change, missions have to deal with considerable uncertainty regarding both the underlying problems and solutions (Wanzenböck et al. 2020). Incorporating these necessary clarification and negotiation processes allows to capture the factors shaping the varieties of missions. Finally, MOIP

are likely to entail higher levels of politicization by prioritizing certain outcomes over others (Boon et al. 2018). In contrast to purely top-down driven policies they also depend to a larger extent on legitimacy and the willingness of the relevant actors to contribute, making a higher involvement of stakeholders and therefore a broadening of negotiation arenas necessary.

Figure 3 summarizes the key characteristics of the different translation processes, the involved actors and key issues of negotiation.

Figure 3:   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. (2021c) 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. 2020b). 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.

2.5   Different types of missions

The growing importance of the concept of MOIP has generated a multitude of approaches applied by national, regional and supranational actors all carrying the label 'missions' (Kuittinen et al. 2018). The term of mission-orientation in this context is also applied at different levels, focusing on large strategic frameworks, as well as individual programs (cf. Larrue 2021 for a classification; similar also Polt et al. 2019; Wittmann et al. 2021a). Strategic frameworks or "umbrella missions" (Polt et al. 2019) in turn may consist of multiple more or less connected individual missions. Missions vary considerably in terms of their scope, their level of ambition, the understanding of necessary changes, and their actual modes of implementation. The shared label of missions therefore entails the risk of ignoring different logics that are inherent to different types of missions which in turn might lead to relying on one-size-fits-all approaches. At the same time, while context factors differ considerably across missions, it is worthwhile to clarify the key logics and characteristics of different approaches of mission policies as they allow to better understand missions and identify shared challenges.

In the context of the scientific support action, a typology of different types of missions was developed to address these questions and provide a foundation for case selection of in-depth case studies (Wittmann et al. 2021a). Extending existing research, one can distinguish three main roots for the variation of missions occurring along the three translations processes of MOIP: mission formulation (solution vs. problem orientation), mission design (directionality of the policy mix, relative importance of behavioral changes, etc.) and mission implementation (design, coordination and forms of implementation). Based on these characteristics, one can distinguish four ideal types of missions:

Accelerator Type 1: These missions pursue a problem-oriented approach and emphasize in particular the importance of research as a means to initiate the desired changes.

Accelerator Type 2: The starting point of this mission type 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: 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.

Transformer type 2: This type is 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.

Especially the latter two dimensions of mission design and mission implementation may contribute to the overall complexity of mission governance, as they both impose multiple requirements on the behavior of actors being in charge of mission realization (cf. figure 4) and imply a varying degree of interaction of STI policy with other sectoral policies. By increasing the instrument mix, the number of actors to be involved, the necessary time horizon, and the importance of potential redistributive conflicts are all increased as well.

There are two important aspects associated with these types of missions. First, they should be understood as ideal types that serve the purpose of analytical distinction of key features. In reality, missions will often combine features of different types of missions or may fall between different types, emphasizing some aspects over others or being affected by different negotiation processes and traditions (cf. section 2.4). Second, it is important to note that there is no blueprint for an ideal mission. The presented mission types represent different understandings of how to achieve the anticipated change. The choice for a certain approach is driven by the underlying societal challenge, the coherence of the perspectives of different stakeholders and the respective societal and political context.

Figure 4:   Types of missions
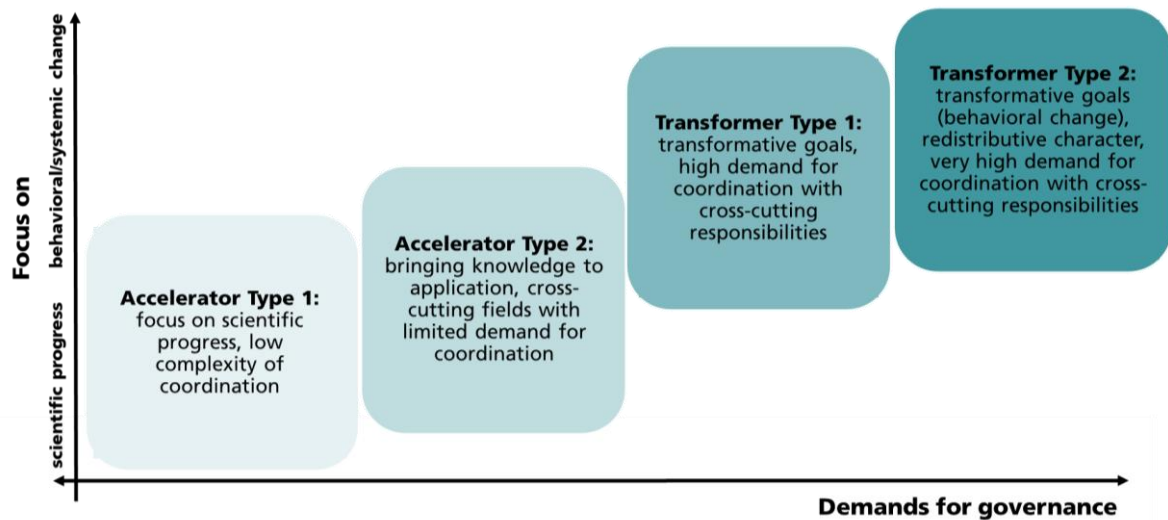
Source: Based on Wittmann et al. (2020a)

Acknowledging that challenges may be addressed in different ways and missions may vary considerably, it is crucial for policy design and implementation to be aware of the implications of different mission approaches. The more comprehensive and transformative the claim of a mission is formulated, the greater its potential impact and the more the requirements for policy-making also differ from established approaches to STI policy and routines of action. A mission that explicitly formulates transformative goals, which usually requires fundamental changes in the socio-technical system (e.g. establishment of new business models, individual changes in behavior, adjustment of political incentives), will hardly be achievable by the means of STI policy alone. Instead, such a mission requires an integrated approach by connecting different policy fields and different actors. In most cases, the classic instrument portfolio of STI policy needs to be complemented with other instrument types such as taxes, regulation, investments in infrastructure and communication measures in order to be able to achieve the postulated goals. A coherent and credible message of mission goals is one of the key factors for the success of missions and can contribute to strengthening the legitimacy of a mission. On the contrary, a mission that formulates unrealistic goals is likely to face difficulties to mobilize actors and achieve the political weight for facilitating the desired changes. Table 2 provides an overview of distinct strengths and weaknesses associated with different types of missions, distinguishing between the overarching types of transformer and accelerator missions. While differences within transformer/accelerator missions may exist, these differences between type 1 and type 2 can be usually considered to be rather in degree than by kind.

Table 2:   Chances and Challenges of different types of missions

|	Accelerator missions	Transformer missions
Chances	1. Targeted approach focusing on selected problems/technologies 2. Limited coordination requirements (actor/ instrument level) 3. Often relies on traditional funding instruments which the STI system is familiar to	4. Promoting comprehensive systemic change (often including behavior change) to deal with societal challenges 5. Comprehensive cross-sectoral and cross-disciplinary approach 6. High legitimacy through transformative agenda as a prerequisite for actor mobilization 7. Involving civil society
Challenges	8. Limited scope that may be insufficient for grand societal challenges 9. Difficulties to achieve actor mobilization 10. Wishful thinking/dealing with uncertainty and avoiding (technological) lock-ins	11. High governance requirements through complex policy mixes and high number of stakeholders 12. High levels of politicization and contestation 13. Requires comprehensive understanding of the socio-technical system

Source: Own elaboration

3   Mission orientation and the HTS 2025

When the HTS was first introduced in 2006 it focused on the targeted support of 17 different technologies and the underlying research disciplines, as indicated in the upper part of figure 6. Already back then, the claim was made that the HTS will serve as a comprehensive umbrella strategy for STI policy of the Federal Government of Germany, based on a holistic perspective of all departments combined in one framework ("eine koordinierte Innovationspolitik ist notwendiger denn je" (a coordinated innovation policy is more necessary than ever) own translation, based on BMBF 2006, p. 7).

The first revised version of the High-Tech Strategy in 2010 (HTS 2020) brought about a reorientation, moving away from a narrow focus on technology fields towards an increased emphasis on societal challenges. Most notably, the willingness to follow a mission-oriented approach was declared for the first time, however without further specifying the kinds of changes this new approach should seek. While the third edition of the HTS mentioned societal actors as important stakeholders, the concept of mission orientation was not further elaborated. It did, however, materialize in the current HTS 2025: Twelve specific missions in three thematic areas (technology and mobility, health and change as well as sustainability and environment; see left circle in figure 6) were introduced.

Figure 5:   Comprehensive overview on four editions of HTS[3]
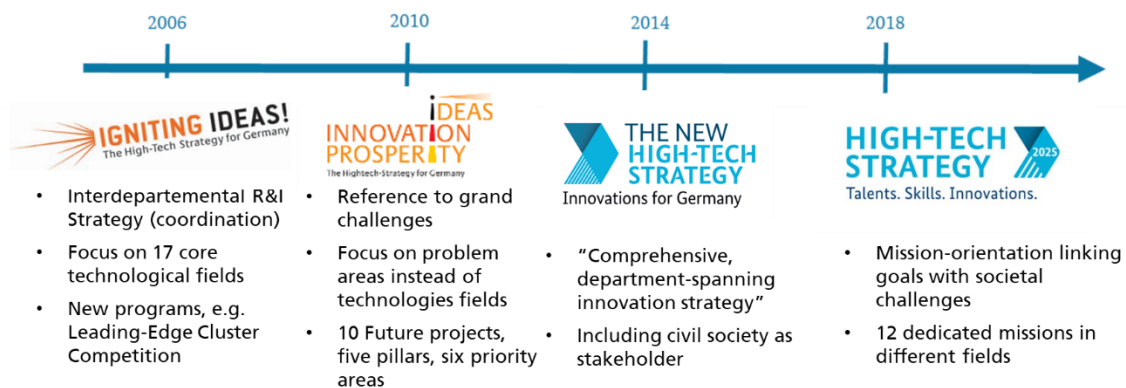
Source: own compilation, word-image trademarks taken from BMBF (2006, 2010, 2014, 2018a)

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[3]   The copyright of the word-image trademarks for all four editions of the HTS belongs to the Ministry of Education and Research and have been taken from the original strategy documents.

3.1 Structure and main elements of the HTS 2025

As defined by the Ministry of Research and Education itself, "the twelve HTS 2025 missions form a unifying framework for diverse current initiatives of the Federal Government" (BMBF 2019, p. 22). The superordinate structure of the HTS 2025, however, depicts three major fields of action that are the key driving forces and structural elements of the entire strategy (see right circle in figure 6):

Tackling the grand challenges – The Federal Government is contributing to overcoming societal challenges through a variety of measures within the framework of HTS 2025. The aim is to achieve leaps in quality that are tangible and perceptible to people in their environment in the six fields of action 'Health and Care', 'Sustainability, Climate Protection and Energy', 'Mobility', 'Urban and Rural Areas', 'Safety and Security' and 'Economy and work 4.0' (ibd. p. 8).

Developing Germany's future competencies – In order to find solutions to the major challenges, we will systematically and continuously develop Germany's future competencies. This is taking place on a three-tiered basis through technology, skilled workers and the participation of committed citizens (ibd. p. 14).

Establishing an open innovation and venture culture – We are working to establish an innovation culture in Germany that is characterized by openness, agility, foresight and trust.[4] We want to put knowledge into effect by transferring it into practical application, strengthen entrepreneurial spirit, and use knowledge and innovation networks in national and international cooperation (ibd. p. 18).

Except for the reference outlined in footnote 4, both strategy cores – the missions and the fields of action – are elaborated further without drawing a specific connection between their explicit goals, milestones and activities. This observation is not necessarily an entry point for critic; however, it does pose challenges in clearly identifying political priorities and leaves room for interpretation on the governance structures of the HTS 2025 as such.

With a view to the latter, namely the political and administrative responsibility for missions, the HTS 2025 is transparent about the fact that actors might change over time: "The ministries and partners involved in science, business and society and also the activities can still change" (BMBF 2019, p. 22). Evidently, though, the role of the Ministry of Education and Research (BMBF) is very dominant as it is leading all of the twelve missions (with co-lead ministries in several cases). This aspect ties in with the observation

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4   Reference to the mission 'Finding new sources for new knowledge'.

that – so far – the majority of policy instruments associated with the missions belong to the typical set of STI funding.

Figure 6:   From technological fields to mission orientation: key components of the first and fourth edition of the HTS
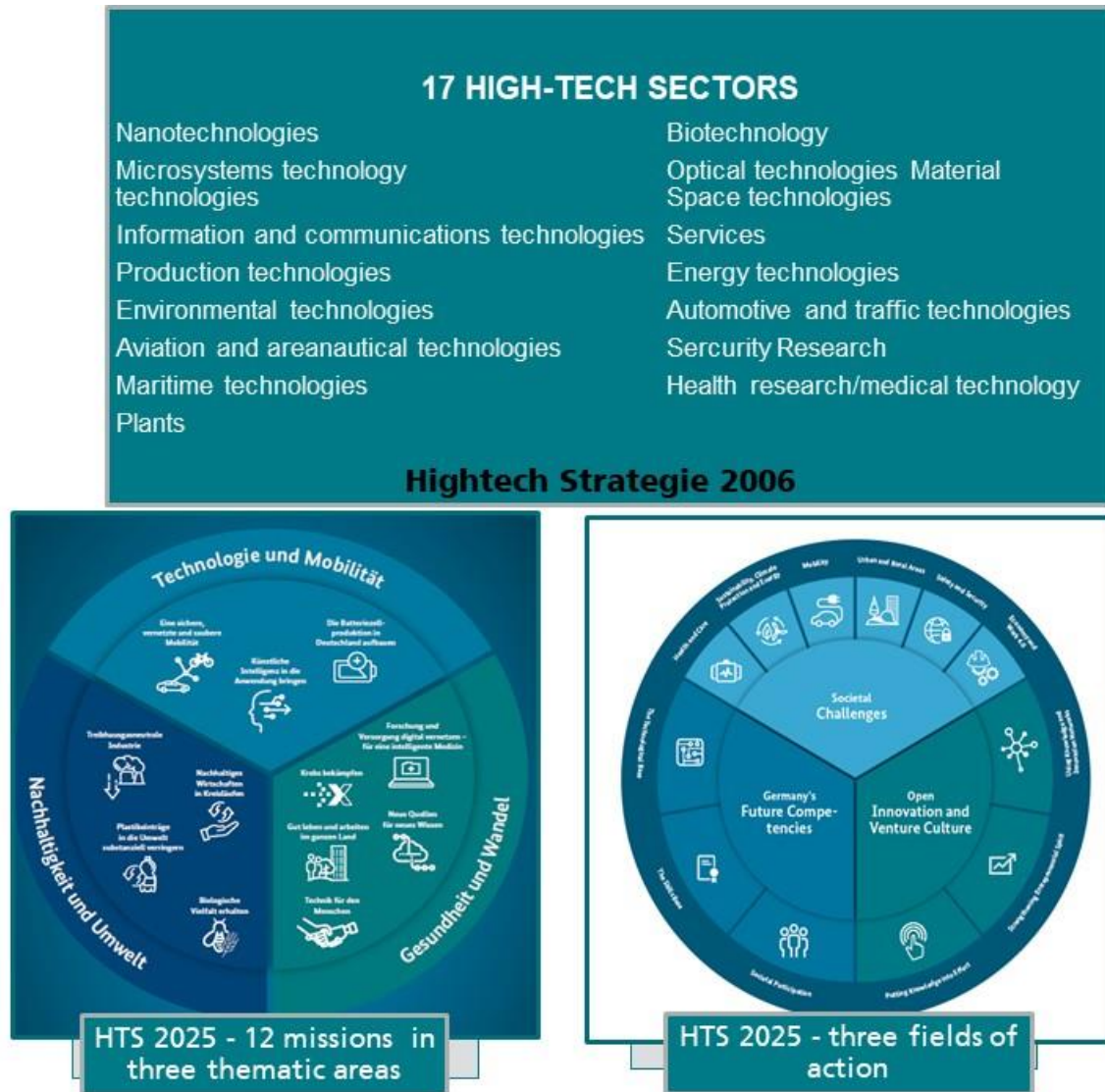
Source: BMBF 2006, 2019; 2021(own translation), left circle BMBF 2021, p. 15, right circle BMBF 2019b; own compilation

Based on official documents and the website, there are quite a few divergences when investigating the involvement of ministries throughout the current legislative period (2018-2021) of the HTS 2025 (table 3), which can be rooted in evolving foci of the missions (change is possible as stated above) on the one hand. On the other, however, as empirical observations throughout the scientific support action have disclosed, in some

cases it can also be interpreted as lacking commitment and weak ownership of mission content by the involved units at the ministries.

Even though we acknowledge the German structural characteristic of a strong division of departmental policy responsibility ("Ressorthoheit"), actors in charge have to be aware that if the MOIP approach – as outlined in 2.3 – is taken seriously, effective cross-departmental commitment and increased joint strategic efforts are indispensable.

Against this background, we will further elaborate on the meta-governance of missions (please also refer to 3.4). In the context of HTS 2025, there are numerous cross-connections made between the identified challenges (e.g., climate change), individual missions, programs (e.g., FONA), strategies (e.g., bio economy strategy) and single policy instruments that appear random at times. It seems that policy coordination (targeted mission specific interaction between ministries) possibly resulting in mutual benefits and gains of different missions and related policy instruments has so far only been performed to a very limited extent or not at all, due to the above mentioned policy silos and lacking joint strategic processes.

Table 3: Overview on missions and involved ministries

| Mission	Lead	Other ministries involved
Combating cancer	BMBF	BMG, BMAS[a,b]
Digitally networking research and healthcare – for intelligent medicine	BMBF, BMG	BMWi
Substantially reducing the plastic discharged into the environment	BMBF	BMU, BMEL, BMWi, BMZ, BMJV[d]
Achieving substantial greenhouse gas neutrality in industry	BMBF, BMWi[c]	
Creating sustainable circular economies	BMBF	BMU, BMWi, BMEL
Preserving biological diversity	BMBF	BMU, BMEL
Developing safe, networked and clean mobility	BMBF	BMWi, BMVI
Building up battery cell production in Germany	BMBF, BMWi	
Ensuring good living and working conditions throughout the country	BMBF	BMI, BMWi, BMEL, BMU, BMFSFJ[a], BMVI[a], BMAS[c]
Shaping technology for the people	BMBF[e]	BMAS, BMFSFJ, BMEL, BMWi

Mission	Lead	Other ministries involved
Putting artificial intelligence into practical application	BMBF	BMWi, BMVI, BMU, BMAS[a], BMEL[a], BMFSFJ[a]
Finding new sources for new knowledge	BMBF	BMWi

Sources: Own compilation based on BMBF (2018b; 2019) and https://www.hightech-strategie.de/ (last accessed 14/12/2021). a) Ministry listed at website of the High-Tech Strategy 2025 (access data December 2021), but not in other documents; b) BMAS is no partner of the NDK as the main vehicle of the mission; c) Listed as relevant actor in early documents on individual missions but not on website; d) Not listed on the website of the High-Tech Strategy 2025; e) Change in responsibility over course of the High-Tech Strategy 2025.

3.2   Diversity of missions

In chapter 2.5 a typology of mission types is introduced to capture and illustrate the different characteristics and claims of MOIP. The twelve missions of the HTS 2025 can be classified as shown in figure 7 and display quite a large spectrum, including rather classic technology driven Accelerator features to comparatively ambitious systemic transformative missions. More than half of the missions fit the category of Transformer missions (two qualify as T1, five as T2), whereas one third focus on applying selected technologies as solutions to respective problems (Accelerator Type 2), while one mission has a strong research orientation (A 1).

Figure 7: Mission types HTS 2025 (own elaboration)
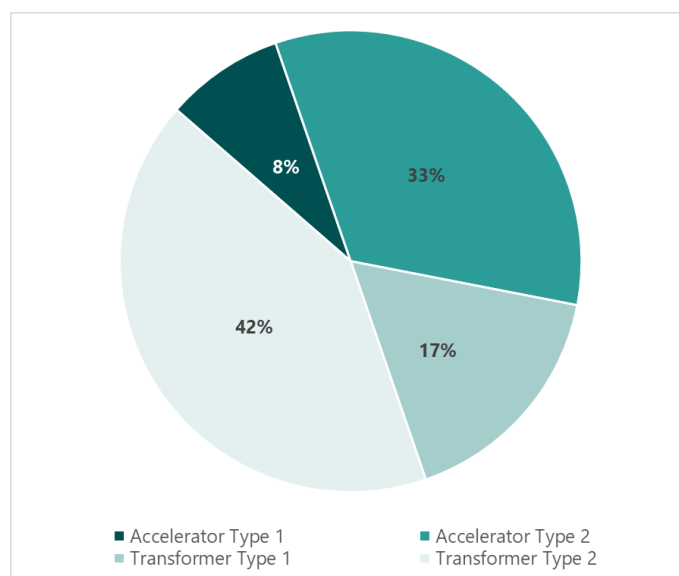
Furthermore, table 4 shows the complementarity of the missions with the explicit three fields of action of the HTS 2025. Notably four missions are associated with the challenges regarding sustainability, whereas two missions are dedicated to improve mobility and health respectively. In the case of the 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.

Table 4:   Contextual connection fields of action and missions in the HTS 2025

Field of action	Topic	Mission (and mission type)
Societal challenges	Health & care	Combating cancer (A1)
		Digitally networking research and healthcare – for intelligent medicine (A2)
	Sustainability	Substantially reducing plastic discharged into the environment (T2)
		Achieving substantial greenhouse gas neutrality in industry (A2)
		Preserving biological diversity (T2)
		Creating sustainable circular economies (T1)
	Mobility	Developing safe, networked and clean mobility (T2)
		Building up battery cell production in Germany (A2)
	Urban and rural areas	Ensuring good living and working conditions throughout the country (T2)
	Economy & work 4.0:	Shaping technology for the people (T2)
Germany's future competencies	The technological base	Putting artificial intelligence into practical application (A2)
Open innovation and venture culture	Putting knowledge into effect	Finding new sources for new knowledge (T1)

Source: Own compilation, see also Wittmann et al. (2021a)

3.3   Mission formulation

Overall, the missions under study reveal a high level of legitimacy. Missions usually 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 High-Tech Strategy 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 one can 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 (as indicated in 3.1). On the other side, also several new topics have been introduced, which were not deeply anchored in previous editions of the High-Tech Strat-

egy. 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. If the added value of a new mission is not clear, this might reduce legitimacy and create conflicts between different actors about responsibilities. In consequence, establishing missions in new fields next to long-standing policies necessitates to identify valuable niches as well as a strong narrative to ensure broad actor mobilization and visibility.

As demonstrated in the first Mission Analysis Report (Wittmann et al. 2020b), 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 represent different types of missions, each prioritizing different understandings on the scope and the way towards necessary changes. Generally, the system analysis demonstrated that the missions under study 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 missions 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 lay down interim goals, in other cases neither goals nor the underlying concepts are clearly specified. When clear definition of goals are absent, this undermines the mission definition and implementation process and creates considerable obstacles for the 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 occurring within the confines of the High-Tech Strategy limits 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 might exist. This illustrates the importance of starting the mission process by a clear vision and clearly formulated goals that provide guidance throughout the whole process of designing and implementing missions.

3.4 Mission design

As indicated above, the mission design ideally needs to accommodate the following main aspects: the mobilization – if possible and adequate – of private resources alongside public contributions, with the latter ideally stemming from a coherent policy mix that is in line with mission goals, and the clarification of responsibilities for the implementation phase of the MOIP.

The missions under study in the context of the HTS give the impression that the delineation of relevant instruments contributing to missions (together) was poorly defined 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. Carrying out mission specific

tasks and processes as, for example, the impact assessment elements Systems Mapping and Inventory for instance, cf. Final Report Vol. 2 (Wittmann et al. 2021b) can guide a sound and strategic mission design for future generations of a STI strategy. The current practice, however, complicates the assessment with regard to the question to what extent the instrument mix is well-aligned with shared goals. Crafting pathways with a clear vision on policy input to achieve necessary impact in the long run is crucial for successful MOIP. 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.

When examining the design of the four selected missions, a first insight gained is that distributive instruments (direct distribution as indicated in figure 8) 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 central 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[5] 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 that aim at changing socio-technological systems 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.

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

Figure 8:   Type of policy instruments for selected missions of the HTS 2025
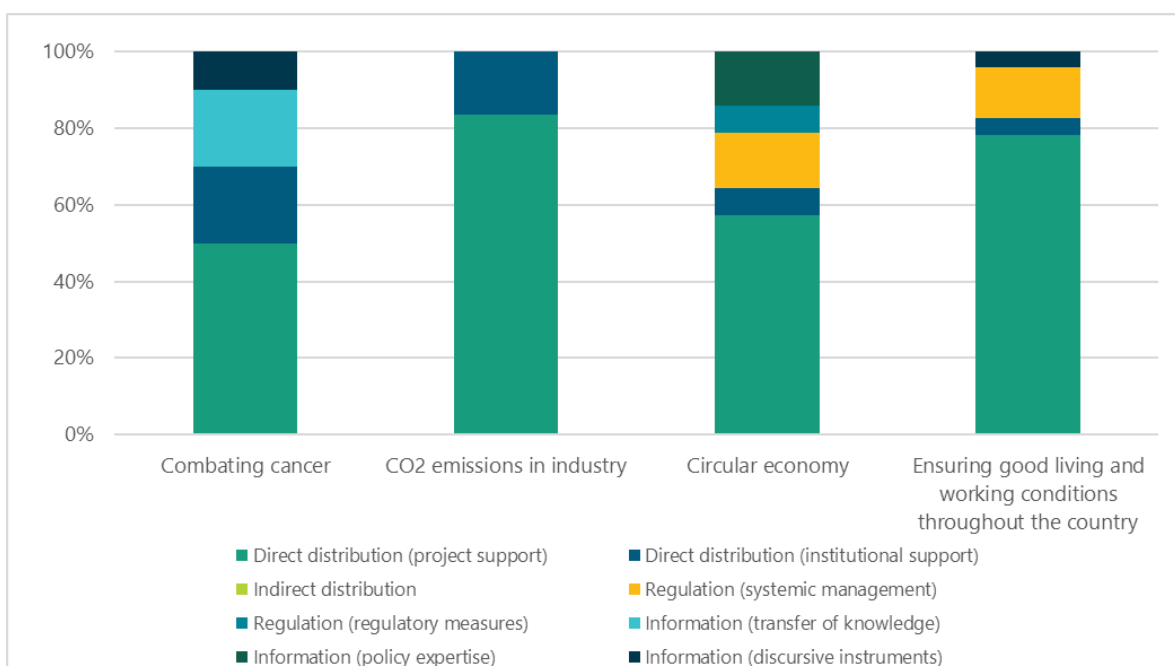
Source: own elaboration based on insights of Wittmann et al. (2021d), classification according to Hufnagl 2010; for missions on CO_2 emissions in industry/circular economy the data contains policy strategies as well as single instruments. Cases presented in the order A1, A2, T1, T2.

In general, the policy instruments in place display a seemingly high specificity with the mission goals of the four mission cases studied, as indicated by the calculation of the Average Instrument Diversity (AID) index (Fernández-i-Marín et al. 2021) that is presented in figure 9. 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. From this perspective, the overall specificity of instrument towards goals appears to be relatively similar and high for all missions under study.

This observation ties in with a core requirement to make MOIP work, as made explicit in the Second Mission Analysis Report:

> *"From our perspective, the instrument mixes for MOIP should not be seen as a collection of thematically connected instruments or sub-strategies, but as a set of policies jointly contributing to the mission goals, complementing each other (cf. Larrue 2021). MOIP do not only require a high degree of coordination at the strategic level, but also an alignment of individual instruments across ministerial responsibilities towards a shared goal, with missions being*

more than the sum of subsumed instruments.[6]" (Wittmann et al. 2021d, p. 79).

Figure 9:   Average instrument diversity (AID) scores for the missions under study
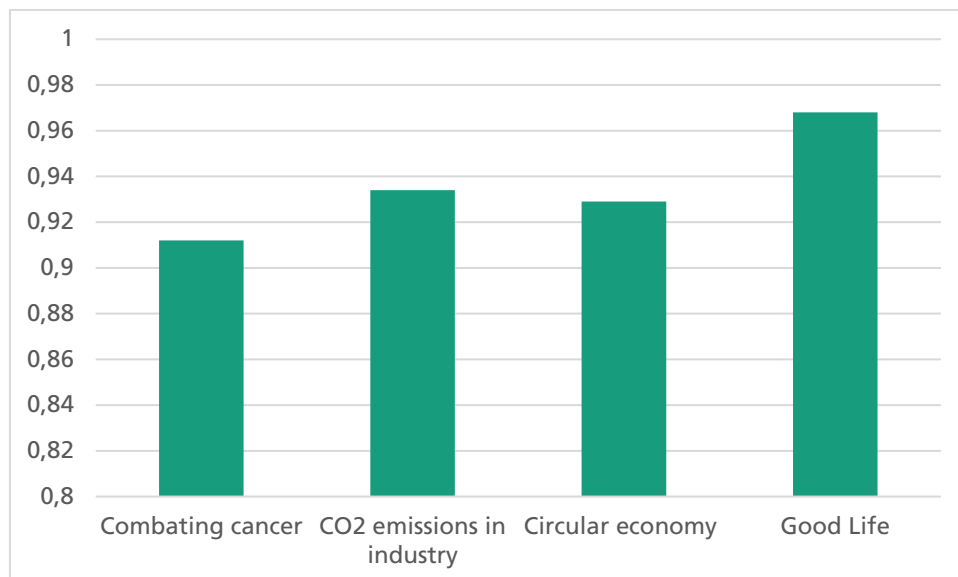
Source: Own calculation

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.[7] 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. Accordingly, the role of evaluation and a culture of flexibility, reflection and experimental learning (Lindner et al. 2021, pp. 31–33) as well as the determination to learn from mistakes and eventually adjust policy instruments is crucial.

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. Figure 10 illustrates the prominent position of the BMBF in the four missions studied with regard to the inputs

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6   A view that is also strongly support by and advocated for by the EFI Commission in its current report: "The implementation of missions requires not only coordinated R&I policy measures, but also a coherent policy mix across all policy areas. The policy approach of MO consequently results in a variety of requirements for policy coordination at the operational level." (Expertenkommission Forschung und Innovation 2021, p. 43, own translation).

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

documented in the HTS 2018 (BMBF 2018b), the progress report (BMBF 2019) and the High-Tech Strategy website.

Figure 10:   Mission inputs by ministries
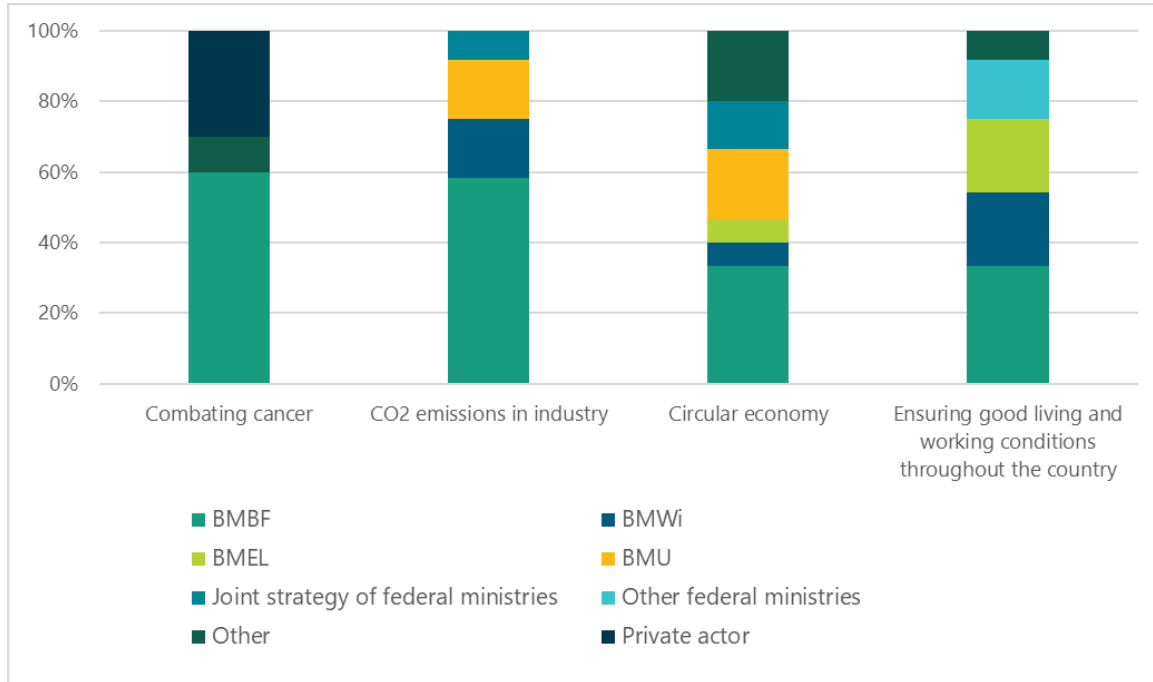
Source: own compilation, in the cases of CO2 emissions in industry and Circular economy the data includes policy strategies. Percentages are based on number of instruments not their financial volume.

Burden sharing in terms of resource mobilization, capacities and joint ownership across ministries and stakeholders of the socio-technological system concerning the mission is of utmost importance. 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.[8] 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. 2021d, p. 77). Overall, the analyses of the mission design along several dimensions that build on the case studies is further outlined in the Second Mission Analysis Report (Wittmann et al. 2021d), the key results of which are summarized in table 5.

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[8]   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).

Table 5:   Key insights of analysis

Issue	Observations	Recommendations
Identification of instruments	Lack of systematic and coherent information provided by official documents; difficulty to delineate inputs to missions	Creation of "inventory" of instruments that contributes to mission achievement and is subjected to the governance of a mission
Link of instruments with mission goals	Missions may relate and contribute to mission goals in different ways (program goals, beneficiary requirements, financing preference for a certain group/topic etc.)	Making explicit for individual instruments how they relate to mission goals to improve coordination and communication of missions
Types of instruments	Strong reliance on incentive creation/direct distribution/traditional project funding	Transformative goals mostly require a broader set of instruments to achieve the postulated goals
Actor/resource mobilization	Only indirect mobilization of other (non-public) stakeholders in most missions	Urge for a cultural shift of burden sharing, possibly more (financial) commitment by industry and mobilization of other stakeholders (good practice Top Sectors NL)
Origin of instruments	Mission combines existing with newly designed instruments	Adjustments of existing policies will be a common phenomenon for MOIP, however, adjustments will be necessary to keep alignment of policies with mission goals
Instrument mix	Lack of integration of at instrument level towards a shared goal	Making use of potential of missions by strengthening the focus on synergies between different instruments pushing towards a shared goal by integrating efforts and treating instruments as connected

Source: Wittmann et al. (2021d, p. 75)

3.5   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 (see section 3.4). 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 German High-Tech Strategy.

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 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   Lessons for future MOIP

This section presents recommendations aiming to further develop the mission-oriented approach against the background of insights developed in the course of the scientific support action. The key focus is on the different phases of mission policies, i.e. the formulation, design and implementation processes.

4.1   Formulating missions

The formulation of missions is a critical moment of utmost importance for the success of a mission. Accordingly, this step should be given much more attention in a future development of missions. Above all, this requires a sound strategic process for the formulation of missions, building on a thorough preparation by the political actors in charge. A coherent and sustainable 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.

At the beginning of the formulation process, the political leadership (usually the Cabinet of the federal government or a single lead ministry, if necessary in consultation with the subnational governments) should develop a basic understanding of which vision the mission will pursue. This includes a precise description of (a) the underlying societal challenge, (b) the overall objective of the mission itself, and (c) by when this overall objective is to be achieved. This process can be supported by methods such as system mapping (see also the evaluation toolbox in the Final Report Vol. 2, Wittmann et al. 2021b) to "take stock" of the status quo.

Given the abundance of grand societal challenges, a first key aspect is the identification of appropriate grand societal challenges that in a subsequent step need to be narrowed down to specific missions with dedicated and quantifiable goals. While a generalization in this regard is difficult, there are several fundamentals that can guide the process. Not every topic is suitable for a mission-oriented approach and might be better addressed with conventional ways of policy-making. A high degree of urgency, necessitating comprehensive change will increase the legitimacy of missions among relevant actors and the wider public and allows to mobilize relevant stakeholders. Closely related is the requirement of high-level political support for a potential mission and the existence of a credible mission-owner who can plausibly advocate the necessary changes. Without sufficient support, missions will face difficulties to mobilize the relevant actors across different sectors and fields. As a consequence, MOIP are more likely to be mobilizing if the societal challenge they address is already high on the political agenda. Against this background, selectivity is an important criteria for choosing missions. Instead of a wide range

of numerous and diverse missions that may not receive considerable attention, it appears more promising to limit the focus on a few but carefully selected missions.

The process of goal formulation serves multiple purposes. Firstly, it creates a convincing narrative in order to enhance the legitimacy of a mission and its potential for actor mobilization. In this context is important to critically reflect on what contributions can be expected from the planned mission – and what lies beyond the scope of the mission. While the call for "ambitious but realistic" (Mazzucato 2018, p. 811) goals is a well-established demand in case of MOIP, its practical implementation turns out to be still a challenge (Lindner et al. 2021). For example, it should be made clear if mission goals include broader political and behavioral changes, or are rather confined to the realms of research and innovation. It might undermine the credibility of mission goals if complex societal change processes are linked to STI policy only, ignoring the necessary changes in the broader socio-technological system. If the scope of a mission is focused primarily on STI policy, mission goals should reflect this, instead of overburdening missions with unrealistic expectations that may trigger public disappointment. A strategy of reformulating goals in line with societal challenges without a sound rationale how STI activities are linked with these changes may overstretch the capabilities of STI policies.

Secondly, a high level of additionality should be a central criteria at this stage, meaning that mission goals are not identical with those of existing strategies. Missions do not emerge in a political vacuum, but usually are embedded in an already existing socio-technical systems. There is little benefit from duplicating existing strategies. Therefore, it must be critically examined which political strategies and agendas already exist at national and international levels (especially EU, OECD, UN) in the thematic field and how missions are related to them. A simple "reframing" of existing strategies under the heading of mission-orientation should be avoided.

Above all, the mission formulation 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 (such as quality of life, avoidable cases of cancer). As mission goals usually will exceed electoral terms, it is moreover necessary to define interim goals. These milestones can help to reduce the tension between long-term mission goals and more short-term election cycles by providing guidance to the involved actors and preventing a detachment of goals and activities. A sound goal formulation should therefore clarify the address aspects: goal hierarchy, goal complexity, goal orientation, and goal commitment (cf. Lindner et al. 2021, p. 24 for a detailed discussion).

Thus, a sound strategic process translating the formulated goals into a comprehensive concept and workable plan of activities and priorities is pivotal for strengthening the missions and ensuring the commitment of all actors towards a common goal. Achieving a common understanding of the goals and scope of a mission and its governance structure is a key step towards aligning activities with the goals of a mission and delineating responsibilities. In the course of formulating the mission, it should be decided if, which and how additional groups of actors should be actively involved in shaping the mission. In this context, three questions in particular should be clarified: First, it must be decided which stakeholders should be involved in the mission. Generally, it is desirable to involve all those actors who can make a substantial contribution to the success of a mission and/or who are particularly affected by the impact of the mission. In this context, it is important not only to include well-organized groups of actors, but also to take into account less well-organized interests and perspectives. Secondly, it must be decided when the identified stakeholders should be involved. In principle, it is desirable to involve stakeholders not only for mission design but also for mission formulation in order to strengthen the ownership of these groups and to incorporate their perspectives early in the process. The joint declaration of the National Decade Against Cancer (NDK) in this regard can serve as a good example. At the same time, it should be avoided that special interests prevent an ambitious mission formulation, leading to an excessive dilution of the mission goals. Finally, it should be decided how the stakeholder engagement process should be designed. Here, mission owners can draw on valuable experiences from previous participatory processes.[9]

Key recommendations

- Mission formulation is a key factor for the success of mission-orientation and should be equipped with sufficient resources and time.

- Missions should be developed in a strategic process – ideally with involvement of key stakeholders – to ensure legitimacy and actor mobilization.

- Missions need to operationalize goals in quantitative (or at least qualitative) terms, define milestones, and specify the underlying concepts to ensure directionality.

- Pursue a selective approach, focusing on few but highly urgent missions that provide added value instead of duplicating strategies and enjoy high levels of political support and commitment.

- Be clear and precise about goals – overburdening STI-driven missions with unrealistic goals will undermine the legitimacy of missions.

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[9]   Cf. the participatory process initiated to support the further development of the HTS 2025: https://www.mitmachen-hts.de/.

4.2   Designing missions

The formulation of mission objectives is a first intermediate step that should be closely linked to the subsequent process of mission design. The translation of objectives into concrete mission activities by the ministries and other stakeholders involved in implementation requires the development of a coordinated mix of instruments based on systematically derived assumptions about the link between measures, effects and the context (see also the toolbox element of impact pathways in the Final report vol. 2, Wittmann et al. 2021b). Without this translation of mission goals into a workable concept, missions are at risk of remaining at the level of wishful thinking and do not unleash the necessary synergies between activities. This process – similar to the mission formulation process – should involve relevant stakeholders, not only to incorporate external knowledge but also ensure the commitment and contribution of these actors to and develop a shared understanding of the mission. This can also prevent a diffusion of responsibilities, as actors might play different roles for different pathways.

In addition, the mission needs to develop a dedicated "instrument mix" that is more than the compilation of measures under one heading or a collection of thematically related policies. Instead, it is about developing a bundle of activities aligned with the mission goals, which are actively brought into the mission by the actors involved and for which they are responsible during its duration. Missions are thus more than the sum of individual instruments and only unfold their effects through the interaction of the various contributions of different actors. The following points in particular are central to the process of mission design:

As missions are usually linked to established policy areas, the realization of a mission takes place in the context of existing policies and rules. For the selection of the instruments, the challenge is to identify those measures that are suitable to contribute to the intended goals and, if necessary, to complement them with additional activities. The aim of mission design should not be a mere compilation of instruments with a thematic reference to the mission objective, but rather a clarification which instruments can contribute to the success of the mission and at what level (creation of beneficial outcomes, initiation of processes, etc.). Only instruments and activities that are carried out by actors who are actively involved in the implementation of the mission should be taken into account. Adding other instruments seems problematic, as the necessary adaptation processes and alignment with the mission goals are not guaranteed.

Secondly, missions can and should make use of the expertise of established policies. We see missions as a purposeful combination of new and existing policies, not as an

attempt to create new policies that work in isolation from existing activities. The experiences and structures of existing measures should be explicitly used, but must be adapted and complemented by appropriate new measures. New instruments and measures can contribute to closing identified gaps, addressing new challenges and advancing the integration of existing measures. In contrast, the use of existing instruments for the design of MOIPs can be a quick and efficient way to "get change going". The question is to what extent these need to be upgraded to meet the new challenges posed by the mission. In many cases it will be necessary to adapt objectives, assess requirements, identify funding priorities, etc. to the new demands. In this context, there is also great potential in the use of pilot projects, real laboratories and (regulatory) experimental spaces. It should be, however, noted that such approaches should be embedded in the mission context in a way it is ensured that the knowledge generated is taken up for the next steps of mission implementation, i.e. that the upscaling of promising solutions is considered as part of the mission from the very beginning.

Thirdly, we see the necessity in mission design to explicitly include all relevant stakeholders who are necessary for the achievement of the goals and to record their contributions to the declared goals. Missions should aim to mobilize further public and private stakeholders abandoning a pure top-down approach, as this does not allow to maximize the potential of most missions. The basic prerequisite for successful stakeholder involvement is an inclusive process of mission formulation (cf. section 2.2) that allows all relevant actors to be engaged and ensures their commitment also in terms of providing resources. Presenting mission activities under a unified label and a coherent external communication might enhance incentives for actors to actively make contributions and align them with mission goals. Moreover, there should be an increasing focus on creating positive incentives to facilitate cooperation between involved ministries. One possibility in this regard might be the creation of dedicated mission budgets that complement the resources provided by mission owners. Such mission budgets that are jointly managed and can create the opportunity for cross-departmental exchange and coordination, incentivizing cooperation as they do not touch upon own resources.

Fourthly, the measures implemented within the framework of a mission should not be seen as a loose bundle of disconnected individual measures, but rather as a purposefully designed mix of instruments. Maximizing possible synergies between individual measures across departmental and sectoral boundaries is one of the great opportunities of the mission-oriented approach. In view of the complexity of the problems to be addressed, this requires the targeted combination of measures with starting points at different levels along the developed measures via impact contexts (thematic priorities, target groups, type of intervention, etc.). A key role in this regard plays the question about

different types of instruments. In most instances, missions require the dedicated combination of STI funding instruments with other measures such as broader investments, taxation, regulation and communication/information and thus goes beyond the boundaries of classic STI policy. Even if the relative importance of the individual types of measures varies depending on the respective mission, a focus on classic STI instruments will generally not be sufficient for achieving transformative goals if these are not complemented with corresponding measures that, for example, trigger exnovation processes. However, this requires a close cooperation of relevant actors between STI and sectoral policies in order to align their policies towards a shared goal. While a dedicated mission budget might be a desirable option to reduce coordination requirements, the bottom-line is the readiness to not only jointly collate instruments and activities but to actually strive for the integration of instruments.

Finally, missions should pursue a portfolio approach concerning instruments, not focusing on single instruments but rather on the complementarity and synergy between them. This may also serve as a basis for experimentation and exploration of new approaches and instruments, such as real laboratories or regulatory sandboxes. However, in this regard it is important to embed such approaches into the mission, i.e. to develop strategies on how to upscale or institutionalize promising solutions, thereby continuously improving the mission based on these results.

In sum, we recommend a sound strategic process not only for mission formulation, but also for developing a workable mission design. This includes the development of impact pathways and an active portfolio management of the instruments of the mission that is aligned with the impact pathways. The portfolio management also forms the foundation for a later monitoring of the mission progress, allows to adapt structures and instruments to newly emerging requirements and changes, and finally provides an opportunity to communicate the results of the mission to the wider public.

Key recommendations

- In the process of mission design involved actors should develop a clear understanding about the link between their goals and activities as well as the instrument mix ("mission instrument mix"). A strategic process to develop this understanding and ensure (formal) commitments of involved actors is therefore key and should be part of the process of developing missions.

- The shift towards a mission instrument mix implies an active portfolio approach that establishes a coordinated and integrated bundle of existing and new instruments provided by public and private actors in order to maximize impact and synergies.

4.3   Implementing missions

Missions require an intensive coordination and monitoring throughout their entire life-cycle. In the context of mission implementation it is particularly important to gather 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 and capable operational management or administrative structures, successful mission implementation cannot be expected. It should therefore be examined how existing procedural rules can be further developed to enable more agile forms of mission management. One starting point could be the establishment of mission-related units or steering groups that operate across departments and are equipped with the necessary decision-making competencies (Weber et al. 2021, pp. 145–147). An alternative to this would be moving up mission responsibility on the hierarchy ladder, delegating mission administration to higher political levels or even external agencies.

Another important task for future MOIP is to increase the transparency during mission implementation. A key condition for this purpose are functional monitoring mechanisms that allow to keep track of missions down to the level of individual instruments in a timely, transparent and comprehensive way. To this end, we suggest to include the compilation of mission specific policy instrument inventories[10] into a publicly available database that covers all missions as well as granular information on the progress of all instruments. Further, it appears advisable to establish dedicated advisory bodies for individual missions, ensuring the continuous involvement of relevant stakeholders and experts in the ongoing implementation processes. In addition to promoting an ongoing exchange of information between the actors involved (governmental and non-governmental), the bodies should be designed in such a way that they can contribute insights to the re-design and adjustment of missions, for example, to develop new instruments addressing identified gaps in the instrument mix, prioritize key activities or suggest necessary adjustments to mission implementation.

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10   Cf. the dedicated chapter in the Final Report Volume 2 (Wittmann et al. 2021b), where such a comprehensive list of policy instruments is introduced.

Key recommendations

- Explore the possibility for the creation of mission-oriented steering groups with sufficient decision-making competencies or adjustment of organizational structures.

- Increase the transparency of mission implementation with monitoring mechanisms and an open data base on the progress of instruments.

- Improve inclusiveness and reflexivity of mission implementation by setting up mission-specific advisory bodies.

5   Conclusions and outlook

Drawing on empirical insights of four selected missions of the German High-Tech Strategy 2025, this report has outlined recommendations for the key stages of missions: mission formulation, mission design, and mission implementation. This concluding section synthesizes the insights and focuses on the overall recommendations for MOIP.

5.1   Ensuring commitment, ownership and resources

Successful missions build on strong commitment to engage in a cross-disciplinary and cross-ministerial collaboration. Without sufficient support it will be difficult to bring the demanding MOIP concept into realization. Governance structures need to reflect the considerable coordination requirements of the mission-oriented approach, especially in regard to cross-ministerial cooperation. By moving mission responsibility to higher political levels, for example at the state secretary level, some obstacles in coordination processes might be overcome. If political priorities and levels of ambition suggest a particularly strong leadership role, it should also be examined whether responsibility for mission policy in general, or at least for missions addressing related policy areas, should be located in the Federal Chancellery. An alternative approach might be to delegate the responsibility for missions to one or several agencies. This way the control and coordination of missions could be removed from interdepartmental competition. In addition, this would make it possible to react flexibly to capacity needs concerning topical expertise etc. Since such a model represents a particularly far-reaching intervention in the German context and raises complex legal questions regarding formal responsibilities, budget rights, etc., a careful examination of this option's feasibility would be necessary. In any case, we consider dedicated high-level political support for the mission-oriented approach as a key prerequisite for successful MOIP.

Further, much more emphasis needs to be directed at inclusive processes that strengthen the ownership of relevant stakeholders, both among public and private actors in the different phases of a mission in order to mobilize resources from private and public actors. This provides the opportunity to develop a joint understanding of missions and at the same time may increase the ownership and commitment of stakeholders. However, this implies that the role of stakeholders is not reduced to the provision of expertise and legitimacy, but presupposes a model of active involvement and co-creation. The Hightech Forum has established as a valuable forum to generate ownership for the mission-oriented approach from policy-makers, academia, industry and society. Such a model should be further strengthened and better connected to the work on the actual mission level.

In general, MOIP actively needs 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 missions. This starts from clear mission goals that allow an assessment when missions can be considered successful and reaches to embedding a framework for impact assessment into the mission design. This also includes an improved reporting of the progress of missions, for example in annual mission progress reports, that reflect both on undertaken activities and the way these activities contribute to the progress of mission towards its goals. The participatory process that has been established to support the HTS 2025[11] is a considerable step in this direction, as it brings together a highly diverse set of actors from science and society in a number of regional dialogue events. This approach should be follow-up on and further extended, to increase the visibility, responsiveness and inclusiveness of MOIP.

Thirdly, as outlined in chapter 4, 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. Taking MOIP serious entails considerably investments, as the benefits of a mission-oriented approach do not come at zero costs, but require considerable administrative resources as well as a new way of planning and implementing public policies. Equipping missions with sufficient human, organizational and financial resources,[12] together with an appropriate institutional design, is a prerequisite for successful missions. Altering the existing model of running missions aside other daily work duties towards a more project-based agile working mode and anchoring the awareness among involved actors for the implications of MOIP are therefore important steps to make MOIP work. To this end, it is inevitable to challenge established routines and practices. Trying to simply re-label existing approaches without the readiness to do things differently will result in shallow missions that primarily exist on paper and are unlikely to reap the promised effects. If necessary, capacities for planning and implementing structural changes in administration of individual missions should be increased through the involvement of external expertise.

Finally, along with the aforementioned points, a focus on selected, central societal challenges can also help to strengthen the legitimacy and visibility of the missions and the High-Tech Strategy as a whole. The mission areas within Horizon Europe are a good

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11   https://www.mitmachen-hts.de/

12   Cf. also the recommendation of Expertenkommission Forschung und Innovation (2021, p. 52).

showcase of this. Therefore, we strongly advocate being selective in the choice of missions for several reasons. Rather than aiming for a high number of missions, the focus should be on depth and thoroughness. The mission-oriented approach places high demands on coordination, cooperation and implementation and thus binds considerable resources of all actors involved. For successful implementation, a focus on selected missions for the central challenges, which are equipped with the appropriate capacities, seems to be more effective and will prevent the actors involved from being overburdened (e.g. policy makers themselves, the agencies for administration (Projektträger) and representatives from industry, science and society). Furthermore, focusing on a small number of missions that mark political priorities also increases the successful communication of MOIP and the HTS as a whole more clearly. This in turn could leverage the commitment of stakeholders and the support by society. Last, but not least, a selective approach may help to overcome the tension between the often long-term goals of missions (sometimes several decades into the future) and the limitation of the mission to a single legislative period. In case of few carefully selected missions, doubts about continuity of missions will be less likely and thus provide a strong and credible signal to all stakeholders.

5.2   Generating added value, creating synergies

A mission approach is most valuable when it is able to generate an added value compared to existing policies. This may happen at two levels.

Firstly, missions should be thought as an attempt to allow for the bundling of existing efforts across different fields and the mobilization of relevant actors for a shared goal. Thereby, missions should not aim for re-labeling existing policies, but strive for an integrated instrument mix, bringing together STI policy with sectoral policies. Therefore, missions should not be approached from finding niches aside established policies, but instead aim for a more integrated approach.

Secondly, particularly challenging but also rewarding are efforts to generate synergies between missions through a deliberate meta-governance of missions. As argued by Amanatidou et al. (2014, p. 425), different societal challenges are inter-connected, so that addressing one societal challenge will have implications for other challenges. MOIP strategies such as the German HTS promise the most added value if they are to not only serve as a collection of – individually relevant – missions, but instead enable and proliferate synergies between different missions. Accordingly, we suggest that, in addition to coherent procedures regarding individual missions (and the underlying processes for formulation and design), also greater attention needs to be paid to the content-related relationships between missions. A more coherent pooling of missions along thematic focal points (beyond headlines) 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. This requires a systemic perspective on the respective problem areas, which also takes into account interaction effects between different dynamics (e.g. between sustainability and mobility) and might include the possibility that several missions jointly address a specific societal challenge. Such a step could free missions from exaggerated expectations, as it would allow to "share burdens" for addressing complex societal challenges between different missions. This approach is also in line with the call for a "selective" approach in the process of defining missions, focusing on the maximization of impacts and not the number of missions or topics covered.

5.3   Learning, adapting and experimenting

In order to move the HTS towards the declared goal of "a learning research and innovation strategy" (BMBF 2018a, p. 61, own translation), we consider changes both at the levels of institutional arrangements and organizational culture as necessary.

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 (see section 4.3). Moreover, the Scientific Support Action to the HTS 2025 proposed a framework for impact assessment with strong formative elements that can support the implementation process in this regard as well (Wittmann et al. 2021b). This could offer continuous monitoring and critical reflection of the respective steps through the reliance on ex-ante/interim evaluations and support for readjusting the missions. To fully maximize the benefits, such an impact assessment should be perceived as an integral part of the mission from the very beginning and cover all phases of the mission.

However, the close integration of mission implementation and impact assessment comes with multiple requirements. First, this process calls for openness by mission owners, perceiving the evaluation as a support for their own activities providing feedback. Second, in order to capture the different facets of MOIP at different levels, the approach requires a considerable amount of data that needs to be gathered and analyzed throughout the course of a mission. In the Netherlands, for example, there are plans to conduct annual analyses of the missions' instrument mixes (Janssen 2020, p. 32).

At a more cognitive level, the shift towards MOIP requires a reflexive approach that is not only a question of institutions and evaluation, but also of administrative, organizational and political culture. The ability to learn from experiences, whether pleasant or not, strongly builds on an open risk-taking culture that allows for the failure of individual instruments and activities. 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. In this regard, the BMBF's new foresight processes appear as a valuable step in this direction.[13] To maximize the added value of such reflexive elements, particularly the integration of the insights gained with foresight methods into the broader political process needs to be strengthened.

The question of coordination is at heart of missions. Resulting from the need of reaching beyond STI policy and widening the actor landscape, missions need to ensure a close alignment of activities at different levels. In addition to horizontal coordination within and between ministries, vertical coordination and coordination with different political levels (supranational, subnational) and private/societal stakeholders is important. Insufficient coordination carries the risk that the transformative potential of missions remains untapped, the use of funds becomes inefficient, the necessary support and cooperation of stakeholders is not possible and that ultimately the mission goals are not reached.

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13   https://www.vorausschau.de/

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