> CHAPTER 3

An overview of the research design

Combining analytical angles, methods and disciplines to investigate STI-SDG relations

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OVERVIEW

The plurality, diversity, and complexity of science, technology and innovation (STI) and of the SDGs require study of diverse actors with diverse methods from different disciplines. Combining methods enables us to look at the STI system from different angles and analytical perspectives.

This chapter explains the STRINGS project's research design:

- We study **four groups of actors** involved in the production and use of STI.
- We bring together **three analytical angles:** past STI priorities in the global research system, current local STI pathways, and views on future STI priorities from multiple perspectives.
- We combine **three main methods:** data analysis to map global STI; three local case studies; and a global Delphi survey.

The different angles of analysis can be compared, combined, and juxtaposed to provide a rich picture of complex STI-SDG relations.

Footnotes for this chapter are on page 47. A full list of references can be found on page 140.

Introduction

The complexity of the relations between science, technology and innovation (STI) and the Sustainable Development Goals (SDGs), as outlined in Chapter 1, means there is no simple nor unique way to map STI to the goals. A common feature of previous attempts to understand the contribution of STI to the SDGs (see Chapter 2) is a focus on a single method or a single angle of analysis (for example, the synergies and trade-offs between SDGs, grassroots innovations, or public STI funding mechanisms). This report looks at the issue more broadly – combining disciplines and methods, and considering STI-SDG relations from multiple research angles to inform various uses in policy and practice.

'By combining methods from a range of disciplines, we provide complementary mappings, characterizations and understandings of the complex relations between STI and the SDGs.'

In a compromise between cutting through the STI-SDG complexities and embracing them, we make use of multiple analytical tools to examine STI-SDG relations for different types of actors, across geographical settings and time horizons. By combining methods from a range of disciplines, we provide complementary mappings, characterizations and understandings of the complex relations between STI and the SDGs. We are then able to build on these mappings and characterizations to illustrate and explain misalignments between STI activities and the SDGs. In Section 3, we propose several ways to steer STI towards the SDGs.

The current chapter outlines the research design of the analytical chapters in Section 2 of the report. It explains the three angles of analysis, each using different methods and focusing on different actors, and how the different angles and methods can be combined.

STI priorities are shaped by multiple actors

For simplicity, we group the actors that contribute to prioritizing, producing and using different forms of STI in four heterogenous and overlapping groups:

- Users, beneficiaries and consumers
- Civil society organizations, advocacy groups and practitioners
- Policymakers, funders, aid agencies and philanthropies
- Public and private research organizations

Figure 3.1 is a stylized interpretation of the multiple relationships between these different groups of actors and their influence on and use of STI.

Users, beneficiaries and consumers are individuals and groups – such as farmers, patients or mothers – who have a range of needs and face various different challenges related to the SDGs, for example, hunger, poverty, climate change and conflict. They address these challenges by producing and using knowledge and innovations. Only a fraction of the challenges faced by users goes on to influence the direction of STI in public and private organizations. The extent of the influence depends on how the challenges are understood, mediated and prioritized by civil society organizations, policymakers, funders and aid agencies. Users may also influence research organizations directly, including those in the private sector (for example, through 'bottom of the pyramid' innovations that aim to sell goods and services to the untapped market of the poorest people).[1]

Civil society organizations, advocacy groups and practitioners act as an interface between users and the other actors. Based on their own political and STI priorities, values, perspectives and interests, they prioritize some of the SDG-related challenges faced by users, and go on to influence policymakers and research organizations.

In turn, **policymakers, funders, aid agencies and philanthropies**, also with their own priorities, values, interests and perspectives, select some of the issues presented by civil society organizations and users, for instance by translating them into certain SDG targets. Based also on these targets, policymakers, funders, aid agencies and philanthropic organizations define research funding priorities and the research and industrial policies that influence public and private research organizations.

Finally, **public and private research organizations** produce much of the scientific research, technologies and market-oriented innovations that could address users' challenges, and help achieve the SDGs. Researchers in these organizations have their own priorities, values and perspectives, and make a further selection of which challenges to address and how.

As a result of these varied interactions, only a small portion of the challenges faced by users are addressed in the

STI system, and they may be tackled according to priorities and values that differ from those of users. Moreover, only a limited selection of the technologies, knowledge and innovations produced by research organizations ultimately reaches policymakers, civil society and users – for example, through new technologies, practices and policy recommendations.

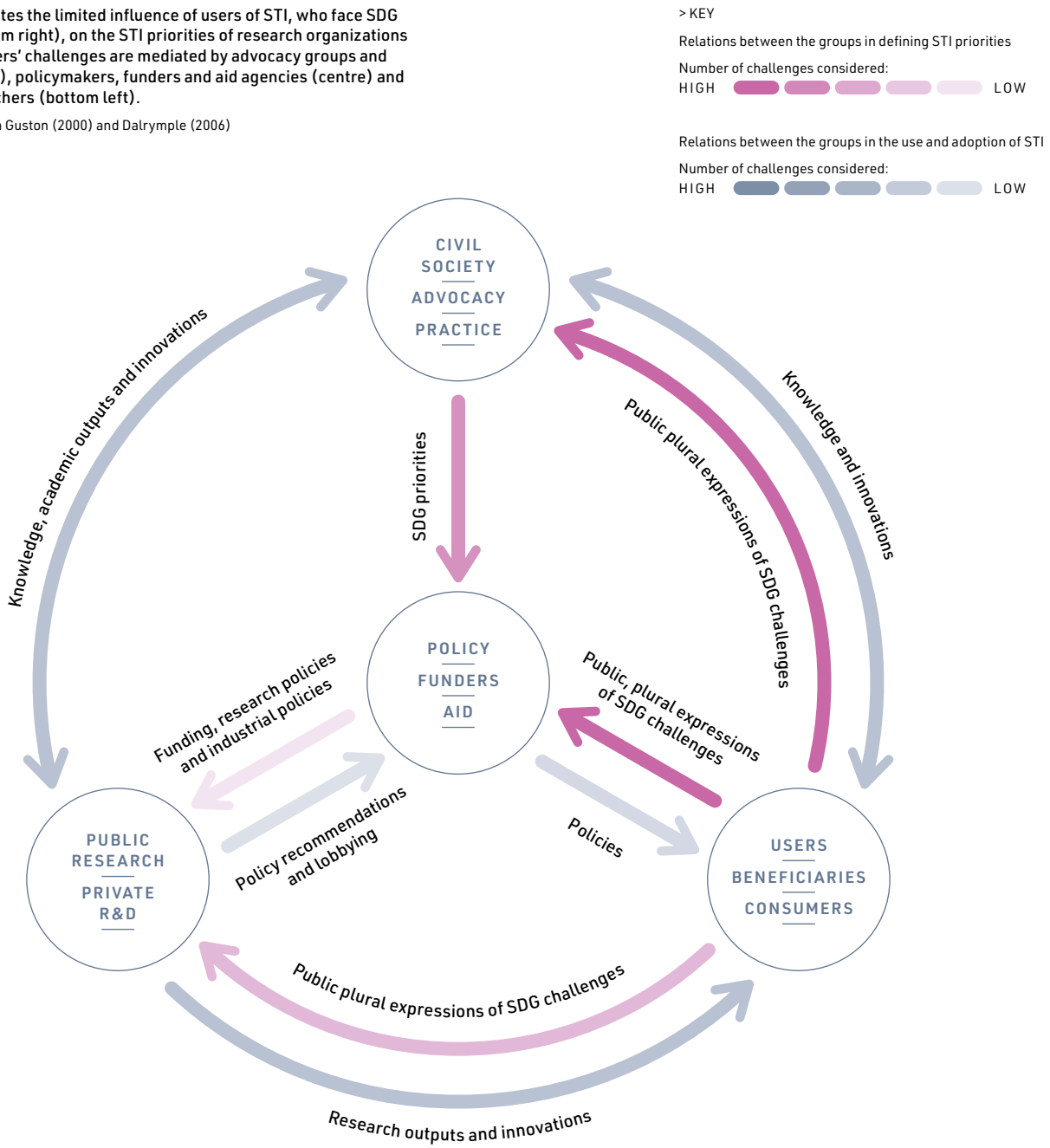
Of course, not all STI is produced in research organizations. Civil society organizations, policymakers and users also produce knowledge and innovate in relation to the SDGs – for example, by adapting existing technologies and pursuing social, policy and grassroots innovations.

The relationships between the four groups of actors are complex, non-linear, and vary across different dimensions of time and space. In the analysis throughout the report we map some of these relationships and analyse how they may influence the alignment between the SDGs and STI.

Figure 3.1 / Setting STI priorities: interactions between actors

The figure illustrates the limited influence of users of STI, who face SDG challenges (bottom right), on the STI priorities of research organizations (bottom left). Users' challenges are mediated by advocacy groups and practitioners (top), policymakers, funders and aid agencies (centre) and individual researchers (bottom left).

Source: Adapted from Guston (2000) and Dalrymple (2006)



STRINGS analytical design and methods

This report uses three angles of analysis to map and characterize STI priorities and to investigate their alignment with SDG-related challenges. The three angles encompass different actors (see Figure 3.1), time dimensions (past priorities, future beliefs and current struggles for STI directions) and geographical dimensions (from local to global).

Each angle is explored through a set of methods and focuses on one or more of the actors, one time dimension, and one geographical dimension.

Figures 3.2 and 3.3 summarize how these methods, actors and dimensions combine in the analysis in forthcoming chapters, and which specific research questions they address.

Figure 3.2 / Overview of the research design: research questions, angles of analysis, actors and methods

	CHAPTER TITLE AND QUESTIONS ADDRESSED	ACTORS	METHODS
ANGLE 1: **PAST** STI PRIORITIES IN THE **GLOBAL** RESEARCH SYSTEM PAST · GLOBAL	**4 A global map of science** **5 A global map of technological inventions** • What SDG-related STI has been carried out where, in what discipline and by which public and private research organizations? • What are the interactions across SDG-related areas of research and inventions? • How does SDG-related STI differ from other types of STI? **6 STI-SDG alignment across countries** • To what extent have research organizations in different countries prioritized research that relates to their own countries' main SDG challenges?	**Public and private research organizations**	**Data analysis; scientometric analysis; text mining; network analysis; statistical analysis**
ANGLE 2: BELIEFS ABOUT **FUTURE** STI PRIORITIES ACROSS DIFFERENT **CONTEXTS** AND ACTORS FUTURE · CONTEXTS	**7 Future STI priorities** • What types of STI should be prioritized to achieve the SDGs by 2030? • What are the synergies and trade-offs between those STI types? • Is there a consensus about future directions of STI? • How far are future priorities aligned with the current priorities in private and public organizations?	**Civil society organizations, practitioners, policymakers and research organizations**	**Global real-time Delphi survey**
ANGLE 3: **CURRENT** DIVERSE **LOCAL** STI PATHWAYS CURRENT · LOCAL	**8 Alternative STI pathways** • How are STI pathways constituted in practice by different actors? • How do the different groups of actors, with their different priorities, interests and values, shape local STI priorities and pathways to address SDG-related problems? **9 Misalignments between STI pathways and SDGs** • How do conflicting prioritizations lead to misalignments between STI pathways and SDG challenges?	**Users, civil society organizations, policymakers and research organizations**	**Local case studies based on document review, interviews, workshops, questionnaires and focus groups** **Multicriteria mapping**

Angle 1

Analysis of past STI priorities in the global research system

Using scientometric techniques we analysed published academic research and patented inventions across the world. These STI documents provide information about research and innovation priorities, which are the result of the complex interactions between actors (see Figure 3.1).

Using network analysis and text mining, we developed a mapping of these documents in relation to the SDGs. This enabled us to study past SDG-related STI prioritizations across countries, organizations, disciplines and SDGs.

We also studied which research areas and technology fields may be best placed to understand synergies and tensions between SDGs, and the extent to which SDG challenges have been considered in isolation, or as interrelated problems that need multiple understandings of STI.

As a result, we proposed a typology of SDG-related research, which can help to improve future prioritization of STI to better address the SDGs (Chapter 4).

Using the data on past STI prioritizations, we then analysed the extent to which countries have changed their research specializations in the past in response to SDG challenges (Chapter 6). This enabled us to consider the alignment between countries' research priorities and their greatest SDG challenges.

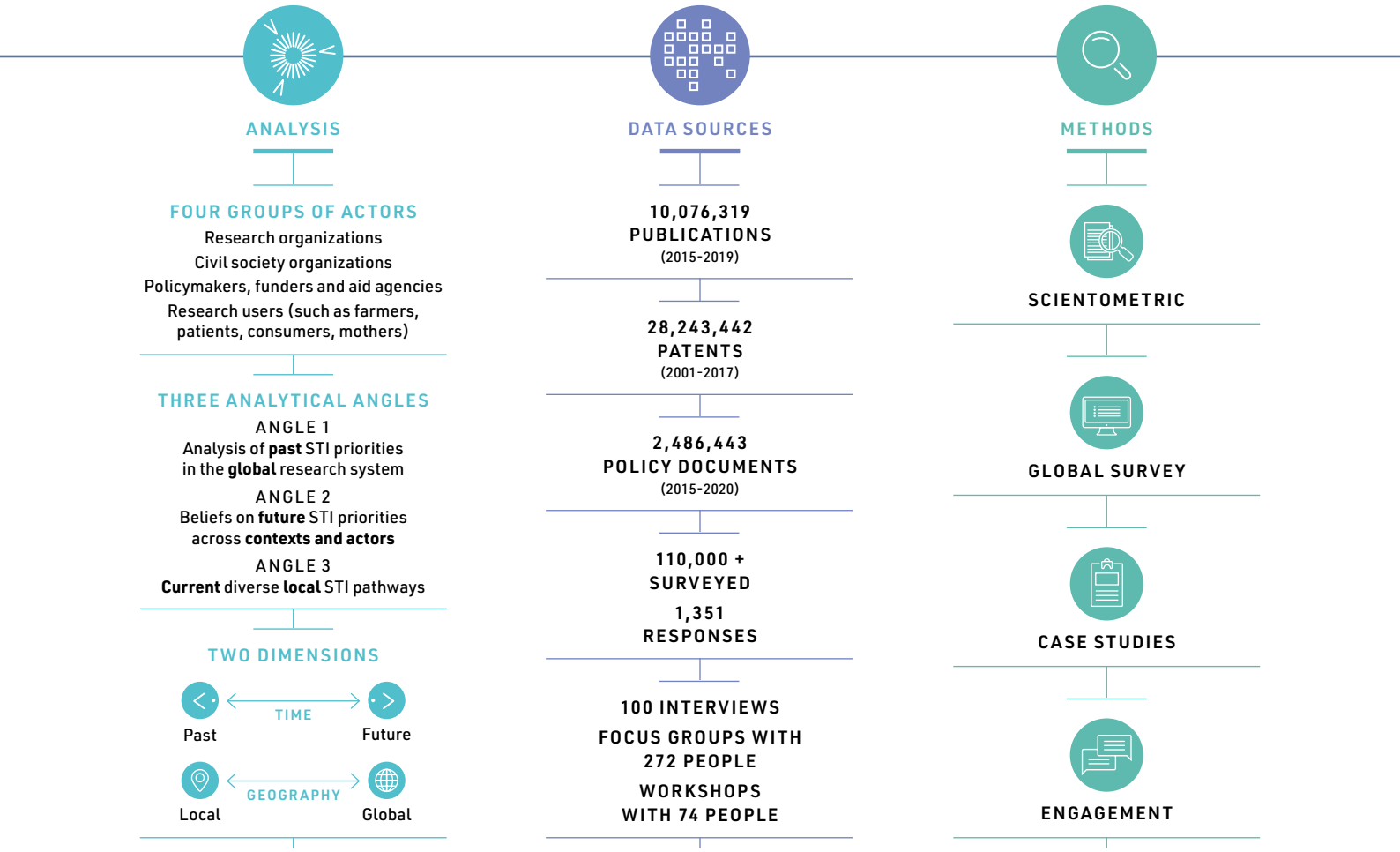
Angle 2

Beliefs about future STI priorities across contexts and actors

We ran a global, real-time Delphi survey, which was sent to more than 100,000 individuals from public and private research organizations, civil society organizations and policymaking bodies, in a range of regional contexts across the world (Chapter 7). Respondents shared their opinions about what STI is most likely to influence the achievement of the SDGs, either positively or negatively, by 2030.

The responses allowed us to better understand the wide range of STI types and priorities, beyond academic and market-oriented inventions, and which of these are more or less

Figure 3.3 / The STRINGS project: a multi-method, multidisciplinary study



controversial across SDGs, contexts and groups of actors. They also provided a deeper understanding of synergies and trade-offs between different forms of STI over different SDG targets.

By contrasting respondents' priorities with the past STI prioritizations of public and private research organizations, we were able to explore alignments and misalignments between incumbent and desired STI.

Angle 3:
Current diverse local STI pathways

Finally, we explored three local case studies, each focusing on a particular SDG-related challenge: reducing the negative impacts of the Chagas disease in Argentina; increasing access to improved rice seed varieties resistant to climate change related stresses in Odisha, India; and tackling conflicts around overfishing in Lake Victoria, Kenya. Using documents, interviews, surveys and focus groups, we studied how different actors, each with their own priorities, understandings, values and interests, have contributed to shaping local STI pathways (Chapter 8). We then used multicriteria mapping to appraise different actors' views on how far each pathway aligns with sustainable development objectives (Chapter 9).

Combining evidence from the three angles

Beyond their separate contributions to mapping STI prioritization and pathways and analysing STI-SDG alignments, the three angles can be combined (Figure 3.4). We combine evidence from the three angles to investigate the relations between the different groups of actors (Figure 3.1) and between the different temporal and geographical dimensions (Figure 3.2 and 3.3).

For example, while the global map of STI in public and private research organizations (Chapter 4) provides an overall description of STI directions, it inevitably lacks context. We supplement this with an analysis of how local STI pathways (Chapters 8 and 9) are influenced by global and regional STI priorities in research. The local case studies illustrate the different ways in which STI pathways and priorities emerge and evolve. These insights help us to interpret the STI directions observed in the global mapping, and to understand how STI can be steered to improve alignment with the SDGs.

The mapping of STI priorities (Chapter 7) highlights the need to improve attention to diverse local contexts, which may not be well understood by global producers of STI.

We also combine our analysis of past STI activities with an analysis of current pathways and beliefs about future STI directions. For instance, in Chapter 7 we compare views about which STI should be prioritized in future with the STI directions that have attracted significant research and innovation in the recent past.

Finally, we consider how past global priorities may have influenced current local pathways, and whether these priorities have helped to support pathways that are aligned with the SDG challenges (Chapters 8 and 9).

Engaging with stakeholders

Throughout the project, we engaged with a wide range of stakeholders, including policymakers, funders, researchers, private sector organizations and international NGOs, both as primary data sources for our analysis and as users of our outputs.

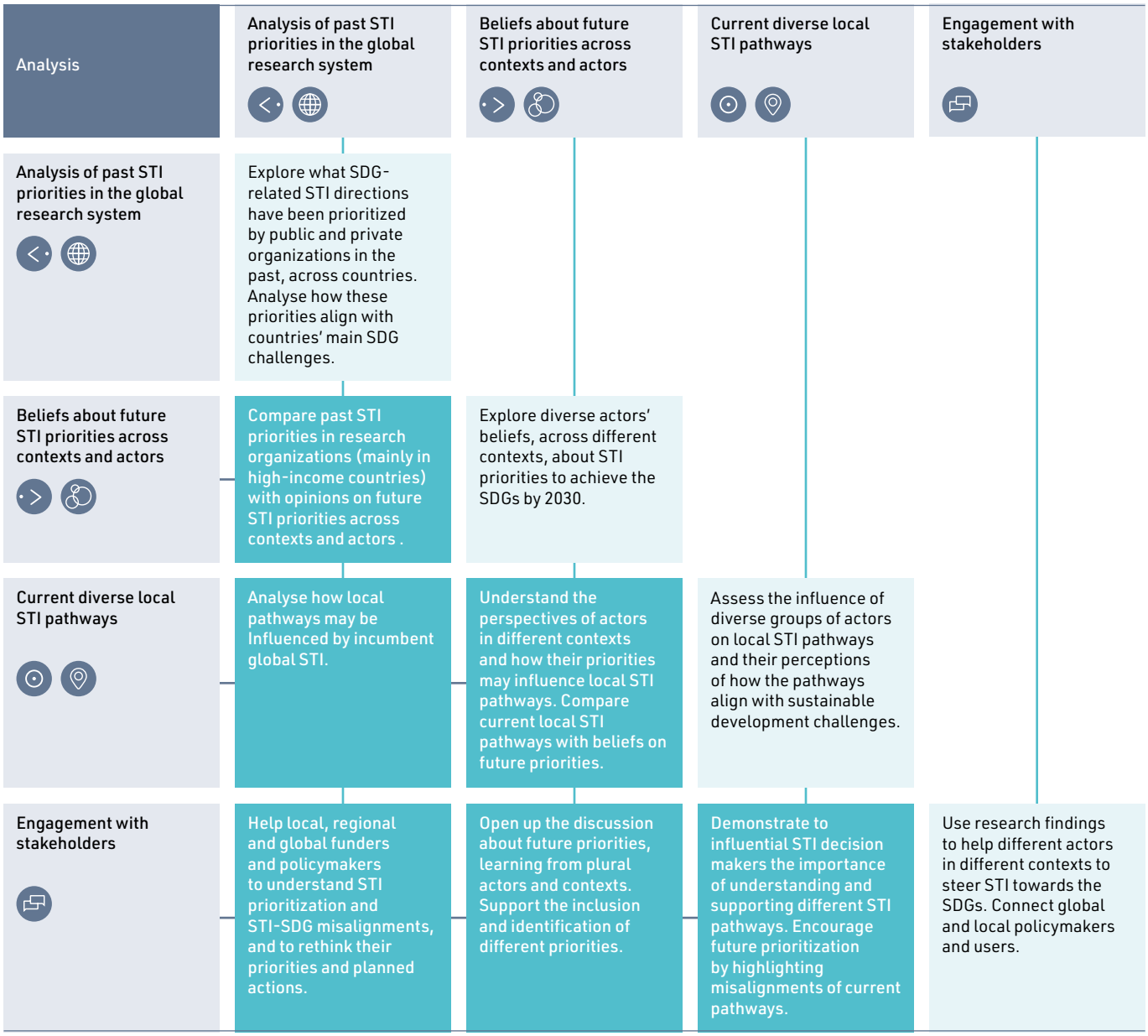
Engagement, which ran through each of the three angles of analysis, involved:

- **Discussing** different STI prioritizations and directions and how they align with SDGs, with local and global users and funders
- **Engaging** the users of our outputs and seeking their feedback on design, format and content to ensure relevance and maximize utility
- **Disseminating** outputs and tools to explore the mappings, pathways and explanations identified in our work
- **Supporting and empowering** actors to orient STI for the SDGs through our outputs and events

A two-day consultative workshop at the beginning of the project helped to fine-tune the research design and to identify key audiences and engagement strategies. This led to the following activities:

- Mapping and prioritizing users of our outputs to facilitate engagement and policy uptake
- Consulting our advisory committee to help formulate research and engagement activities that can maximize the project's impact
- Gathering feedback from different groups of actors on the first drafts of all chapters
- Ongoing communication, for example, through blogs, webinars, social media and newsletters, to raise awareness of and drive engagement with our work
- Delivering an empirically-based, globally-produced analysis that can empower policy action in the form of this report, accompanying materials and tools to explore the mappings, pathways and explanations identified in the project

Figure 3.4 / Combining analysis to understand STI priorities and their alignment with SDGs



The figure illustrates the various ways in which the different analytical angles (pale blue) and comparisons between them (dark blue) contribute to our understanding of STI priorities, how they differ in different geographical and time dimensions, how they are generated, and their alignment with the SDGs.

Notes

1. Prahalad and Hart, 2002.