European Commission

Fostering Knowledge-Sharing Within and Among S4P Actors

Mutual Learning Exercise on bridging the gap between science and policy

First thematic report

PSF CHALLENGE

HORIZON EUROPE
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Independent Expert Report

Research and Innovation

Fostering Knowledge-Sharing Within and Among S4P Actors. Mutual Learning Exercise on bridging the gap between science and policy

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Mutual Learning Exercise on bridging the gap between science and policy

First thematic report

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FOSTERING KNOWLEDGE-SHARING AMONG AND WITHIN SCIENCE-FOR-POLICY ACTORS

1. Introduction

1.1. About this Mutual Learning Exercise

PSF Mutual Learning Exercises (MLEs) are demand-oriented, focused on specific R&I topics of interest to several countries, and intended to promote mutual learning between countries volunteering to take part. This MLE aims to facilitate the exchange of information, experiences, and lessons learned as well as to identify good practices in relation to the various Science for Policy (S4P) models and approaches at national level. As a by-product of the peer-learning, the MLE could also contribute to the implementation of European Commission policy activities supporting the uptake of science into policymaking through the establishment of a European S4P ecosystem in line with the principles and values of the 'Pact for R&I in Europe', a key instrument in meeting the ambitions of the European Research Area (ERA).

This MLE specifically aims to:

- Inspire and guide Member States and associated countries on what can be achieved through different approaches for fostering the capacities of national S4P ecosystems and supporting the uptake of scientific knowledge by policymakers.

- Enable participants to better understand the diversity of the national S4P ecosystems across Europe and help them to identify relevant needs, challenges, opportunities, and effective ways to address them.

- Identify and facilitate the exchange of best practices based on available evidence and collective experience, providing Member States and associated countries a toolbox on which they can draw to enhance S4P capacities according to their specific needs and conditions.

- Contribute to policy dialogue on the establishment of a European S4P ecosystem – based on the interconnection of national systems – to bolster Europe's collective capacity to take on the complex challenges of our time in a legitimate, comprehensive, coordinated, and efficient manner across Europe.

1.2. Policy context

The 2021 'Communication on better regulation'[1] emphasised the importance of scientific evidence as a cornerstone for better regulation, which is "vital to establishing an accurate description of the problem, a real understanding of causality and therefore intervention logic; and to evaluate impact". The importance of scientific findings and evidence-based knowledge for policymaking in the EU was further highlighted in December 2023 when the Council approved conclusions on 'Strengthening the role and impact of research and innovation in

[1] EC. (2021). Better regulation: Joining forces to make better laws. https://commission.europa.eu/document/199176cf-6c4e-48ad-a9f7-9c1b31bbbd09_en

the policymaking process in the Union'.[2] The Council noted that all fields of science, including social sciences and humanities, by producing evidence-based knowledge, "should play a more significant role in the policymaking process for the identification of political challenges, the analysis of the state of the art, [and] the framing of the solutions". As recognised in the 2022 Commission Staff Working Document on 'Supporting and connecting policymaking in the Member States with scientific research', [3] S4P interactions are best understood as part of a broader ecosystem, conceptualised as "a complex of organisational structures and entities, processes, and networks that interact to support the mobilisation, acquisition, synthesis, translation, presentation for use, and application of scientific knowledge in policymaking processes".

To strengthen and improve S4P processes, Member States and the Commission have already developed many instruments. One of these is the European Commission's Scientific Advice Mechanism (SAM), composed of a Group of Chief Scientific Advisors (GCSA) supported by the Science Advice for Policy by European Academies (SAPEA) consortium and a secretariat in DG RTD. SAM has provided useful inputs on how to understand the challenges of S4P,[4] highlighting for example that there are many distinctive answers to the question of how science should and could be used for policymaking.[5]

In recent years, the Joint Research Centre of the European Commission (JRC) has played a central role in mapping and promoting science for policy initiatives. It is now well positioned as a S4P boundary organisation and knowledge-broker, providing extensive support to Member States in understanding the development challenges of S4P ecosystems.[6] Among the outputs from these efforts are mappings of S4P ecosystems in several Member States, extensive networking activities among relevant stakeholders, and guidelines for evaluating S4P ecosystems.[7] Several Member States have actively developed their S4P ecosystems,[8] and there is now wide interest among research-performing and -funding organisations to more actively support policy engagement.[9]

1.3. Aims and scope of the Thematic Report

In the current debates on S4P, there are still many open questions. These relate, for example, to the role of S4P in the broader knowledge ecosystem that underpins policy development and decision-making, the processes that make knowledge actionable, and the definition of S4P itself. Scientific knowledge production is changing, and broader societal problems require anticipatory knowledge creation that integrates data, knowledge, and interpretation across epistemic boundaries. Mutual learning in S4P, therefore, is not only based on sharing existing knowledge but also about creating new understanding of the task at hand.

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[2] Council of the European Union. (2023). Strengthening the role and impact of research and innovation in the policymaking process in the Union.

[3] EC. (2022). Supporting and connecting policymaking in the Member States with scientific research (SWD(2022) 346 final).

[4] SAPEA. (2019). Making sense of science for policy under conditions of complexity and uncertainty. Science Advice for Policy by European Academies. https://doi.org/10.26356/masos

[5] Ibid.

[6] Šucha, V., & Sienkiewicz, M. (2020). Science for Policy Handbook. Elsevier. https://shop.elsevier.com/books/science-for-policy-handbook/sucha/978-0-12-822596-7

[7] Pedersen, D. B. (2023). An evaluation framework for institutional capacity of science-for-policy ecosystems in EU Member States. Publications Office of the European Union. https://doi.org/10.2760/609597

[8] Cf. e.g., https://knowledge4policy.ec.europa.eu/evidence-informed-policy-making/topic/reforms-science-policy-7-member-states_en

[9] Dotti, N. F. (2024). Guidance on Science for Policy Activities: Principles, Actions, and Examples. Science Europe. https://zenodo.org/doi/10.5281/zenodo.10911927

To facilitate mutual learning, an earlier Discussion Paper provided a conceptual framing of S4P using concepts that have been developed in organisational knowledge management and science and technology studies. This broader framing of S4P as knowledge-for-policy highlights both the need to have a refined view of scientific knowledge production and on the conditions of making knowledge actionable in the policy process. In this light, **S4P can be understood fundamentally as a knowledge management problem**.

In earlier discussions on S4P, a common starting point has been the need to provide relevant scientific information to policymakers, so that alternative policy options can be assessed, and decisions can be based on the best available evidence. This makes policy communication and policy advice salient features of S4P; 'translating' science into language that policymakers can understand becomes a central challenge.

This approach to S4P could well be called the "old-school" model of S4P. Learning, in this model, is about transferring knowledge from a teacher or a textbook to the learner. As in early models of innovation diffusion and knowledge transfer in scientific networks, knowledge flows in a relatively linear way from upstream sources towards end users. Learning becomes a problem of 'knowledge acquisition'.

This linear model was largely rejected when the knowledge-based view became one of the dominant starting points in organisational studies in the 1980s. 'Constructivist learning' models became influential in social studies of science, organisational knowledge management, and innovation policy. In these models, knowledge transfer becomes a learning process, where active sensemaking, knowledge construction, and social learning are the key to success. For S4P, this means a shift from the old-school S4P 1.0 towards a knowledge-based framing. This shift is a central feature of what the JRC has called S4P 2.0.[10]

This Thematic Report summarises the discussions held during the first MLE country visit to Leuven, Belgium on 27 and 28 June 2024. The meeting discussed both the scope and nature of S4P as it emerges in the knowledge-based framework, and thereafter focused on the main topic of this report: **fostering knowledge-sharing among and within the S4P actors**. During the meeting, a series of challenges, good practices and success factors related to fostering knowledge-sharing among and within the S4P actors were shared by participants and are reflected in this document. The report also introduces some key knowledge-management concepts that were used to kick off discussions, enriching the discussion paper with insights and feedback from the participants.

2. Challenges in S4P

During the meeting, key concepts that underpin S4P 2.0 as well as the practical challenges and potential solutions were discussed in rich detail both in breakout groups and in plenary sessions.[11] Sentence-level coding of the meeting minutes revealed over 200 subjects that were discussed and mentioned by participants. The most frequently cited issues relate to the current fragmentation of S4P ecosystems in participating countries and the need to understand and map the S4P ecosystem and its actors. The lack of knowledge uptake by policymakers and the need to make knowledge actionable were among the prominent topics, which also included questions about the right ways to engage citizens, the importance of dialogue and interaction, the development of trust, and the need to embrace complexity both in the S4P ecosystem itself and when formulating policy options for often multifaceted and

[10] Šucha, V., & Sienkiewicz, M. (2020). Science for Policy Handbook. Elsevier. https://shop.elsevier.com/books/science-for-policy-handbook/sucha/978-0-12-822596-7
[11] The Appendix shows some examples of the discussed topics.

‘wicked’ social problems. The need to develop capacity for communication and collaboration for both academics and administrators was noted, and issues such as the timing of advice, the right administrative level for advice, and the need to find expertise beyond the usual suspects were highlighted.

The broader framing of S4P as a knowledge-management challenge and knowledge-for-policy also raised questions about the appropriate scope and definition of S4P. In a knowledge-based view on S4P, it is clearly important to understand what types of knowledge and evidence are relevant for S4P. The next section addresses this question, reflecting the discussions and presentations in the meeting.

3. Science and knowledge in S4P

3.1. S4P in the policymaking knowledge ecosystem

Policy development and political decision-making use many different forms of knowledge. Some participants noted that S4P has traditionally focused on facts, evidence, and insight produced by scientists, yet a broader knowledge-for-policy perspective may include sources of knowledge that are beyond the scope of S4P. For example, citizens may provide expertise and knowledge for policymaking. Should they be included as actors in a S4P ecosystem? What, exactly, do we mean by science in S4P? The participants also highlighted the point that S4P literature often starts with the disclaimer that science should not be understood in its narrow English sense which focuses on “hard (natural) sciences”. Some participants raised the question whether, for example, economic knowledge and knowledge produced in foresight activities should be included.

3.1.1. Research-informed knowledge in S4P

Science, in its broader German interpretation of *Wissenschaft*, includes all sciences. Social and human sciences are particularly important for policymaking, and, according to the participants, these are also often easier to communicate to policymakers than natural sciences per se. At the same time, it is also clear that there are many competing knowledge claims within the sciences, and different disciplinary traditions have divergent theoretical framings and views on what counts as evidence. This is a challenge for policymakers as policy development often requires multidisciplinary collaboration and integration of alternative points of view.

Empirical sciences are special among sciences as their knowledge claims can be tested. Both philosophers of science and social studies of science have, however, emphasised that also empirical evidence depends on theoretical constructs and shared beliefs that can vary across scientific communities. Knowledge, in general, is not merely an objective reflection of the state of the world but rather a social phenomenon. In the global ‘knowledge community’, it is possible to find individual scientists backing every possible policy choice, and in the current media environment the credibility of scientists is often contested. Large language models (LLM) can be prompted to provide evidence-based justifications for many alternative policies that may look convincing and definitive also when the world remains uncertain and unpredictable. It is, therefore, important to be clear what are the criteria for knowledge and evidence in S4P.

In S4P, a useful starting point is to acknowledge that science consists of many disciplines and multiple epistemic communities within each discipline. This plurality is an inherent characteristic of science. The validity of scientific knowledge claims, therefore, is fundamentally rooted in quality criteria that are accepted in the scientific community in question. Beyond peer assessment, there are important criteria that are more universally accepted among the broader scientific community. Most importantly, scientific knowledge claims must be rooted in quality-controlled research processes. This implies coherent methodology and argumentation.

An important aspect of scientific knowledge is also its traceability and provenance. This includes the possibility to step back and ask the validity of those assumptions that underpin knowledge claims. Traceability has traditionally been based on referencing earlier research that provides relevant context and evidence. For effective S4P, it is important that this system of knowledge accumulation works. As scientific publishing is struggling with an avalanche of academic outputs that bypass efficient quality assurance mechanisms, exaggerated by the increasing use of LLMs in academic writing, reliable and trustworthy S4P also needs to sift through vast bodies of low-quality research.

Policymakers use many different types of knowledge, but S4P is concerned with research-informed knowledge that builds on existing science and which can justify and defend its claims in the scientific discourse.

In this view, knowledge in S4P is more than what may be found in scientific journals, databases, and reports. It is the informed opinion of scientific experts that is based on critical reflection, good argumentation, and acknowledgment of the limited scope of validity of knowledge claims.

The challenge of assessing the quality of scientific information and measuring the S4P ecosystems beyond purely procedural indicators, such as connectivity and openness, was noted in this MLE. Trustworthiness is becoming a key challenge in the future knowledge landscape and will also be a topic specifically addressed by the participants in a forthcoming MLE meeting.

3.1.2. Science advice and the linear model of S4P

A knowledge-based view on S4P puts emphasis on “downstream” components, where policymakers transition from being **knowledge consumers** to **active co-producers** of knowledge. Participants during the country visit highlighted the challenges associated with such co-production due to the different languages of science and policymaking. The need to make knowledge “actionable” was among the most frequently mentioned problems in S4P. Similarly, the need to develop “absorptive capacity” among policymakers was found to be important in fostering knowledge uptake. A number of participants referred to the lack of proper incentives to make research results useful for policymaking, but also recalled frustrations when trying to do this while policymakers bluntly ignore scientific evidence.

To some extent, these challenges reflect a linear model of knowledge flows in S4P. The old-school linear model of S4P was clearly rejected by the participants, but it is useful to contrast some of its key assumptions with a more ecosystem-oriented view on S4P.

LLMs consolidate vast amounts of literature, including on S4P. One way to describe the historical consensus on what S4P means or entails is to ask a LLM. With minimal prompting, Anthropic’s Claude Sonnet 3.5[12] explains that S4P consists of four key subprocesses: scientific research that is the starting point for the process; data analysis; expert consultation

[12] https://www.anthropic.com/news/claude-3-5-sonnet

and insight generation; science communication; and, finally, policy formulation. This S4P model, based on many texts written about the topic, is depicted in the figure below.

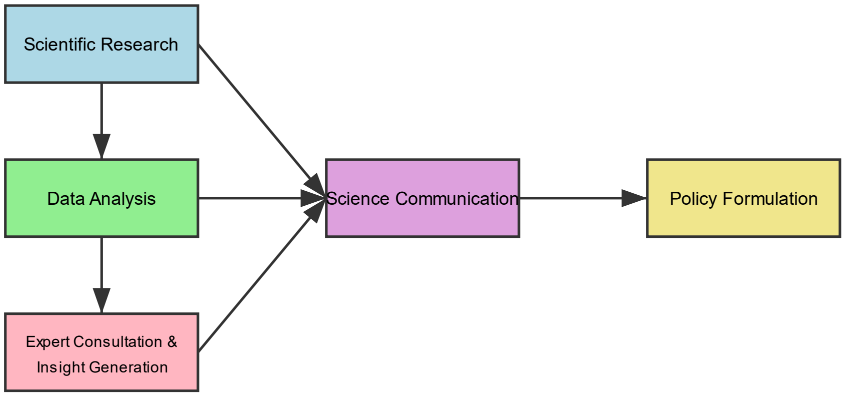

Figure 1: S4P process as depicted by the Claude 3.5 Sonnet LLM with minimal prompting

In this model, S4P essentially becomes a problem of communicating research results and advice to policymakers in a usable form. Science and policy are understood as two domains, separated by a "science-policy boundary". Specialised organisations and individuals thus become key actors in moving knowledge from one domain of knowing to another.

This simplified model obviously has a very monolithic view on both science and policymaking, and it neglects many interactions in the S4P system. More interestingly, it depicts policymakers as passive recipients of information and knowledge.

As noted above, S4P has moved toward more interactive models, where dialogue, collaboration across boundaries, and co-creation have become prominent themes. This shift redefines what we mean by knowledge in S4P but it also redefines what is included in a S4P ecosystem. The boundary between science and policy becomes permeable and expands into new arenas of interaction. Knowledge construction processes in policymaking become important for understanding what makes knowledge actionable. Not all knowledge is "serviceable" for policymakers, and S4P scholars have documented the importance of culturally specific styles of public reasoning and knowledge-making that render scientific knowledge into more acceptable/usable forms given different policymaking contexts.[13] The participants highlighted the importance of developing novel arenas for dialogue, knowledge co-creation, and sensemaking among S4P actors, the need to understand the different logics under which the various actors operate, but also better understanding of who the relevant actors in the system are.

[13] E.g., Jasanoff, S. (2007). *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton University Press.

3.1.3. AI and post-traditional S4P

The impact of AI tools such as LLMs was highlighted as an emerging key challenge for S4P. This challenge can also be usefully understood in the context of the linear S4P model. If S4P is understood as a process of discrete steps consisting of collecting, consolidating, summarising, and translating research outputs for policymakers in a timely fashion, LLMs can potentially automate much of this process.[14] From a policymaker's point of view, S4P becomes a problem of prompting a LLM to check what science has to offer to policy formulation.

As pointed out above, quality control and traceability become important in this context. At present, these are unsolved problems in AI. It would be possible to develop LLMs for S4P by carefully curating inputs that are used to train the system. As LLMs are based on statistical characteristics of the input data, such systems tend to miss recent scientific developments and emphasise historically accepted but perhaps outdated views. This, indeed, is illustrated by the LLM-generated linear model of S4P shown above.

General-purpose LLMs are also conditioned by human and AI-generated feedback that expresses views and norms considered acceptable by the system developers. Although there are technical possibilities to mitigate such problems, the possibilities and challenges remain uncharted territory.[15] The wider use of AI and machine-learning can also amplify the perceived policy importance of those disciplines that can most easily generate data and use AI in their knowledge production. The appropriate use of AI in S4P will, therefore, be an important topic for S4P actors.

3.1.4. Foresight and future-oriented evidence in S4P

Several participants noted that S4P gains visibility under crises, and that scientific advice is often required ad-hoc, when urgent needs emerge. Anticipatory knowledge production, however, is needed as many policy challenges are complex and multidisciplinary, and because interpreting and understanding scientific evidence often requires absorptive capacity in administration – rapid decisions demand long-term capacity development. Most importantly, beyond being able to understand scientific content, policymakers also need to understand why such content is relevant in the emerging future.

Reactive knowledge production that addresses present policy problems and more forward-oriented knowledge production have very different requirements. Knowledge production in the academic world is largely based on methodological research that requires long-term commitment, and whose results are often published with long delays. The participants noted that policymakers, however, often require actionable knowledge and fast answers to specific questions that arise in policy practice. Critical research on socially important questions may reframe the policy agenda and produce new ways to understand the root causes of problems. In practical decision-making, policymakers often operate within given conceptualisations of the task at hand, and science is often expected to just provide the answer that allows decisions to be made. Critical reflection may then simply appear as an unnecessary complication or a distraction. One of the common assumptions that shape S4P debates is

[14] Tyler, C., Akerlof, K. L., Allegra, A., Arnold, Z., Canino, H., Doornenbal, M. A., Goldstein, J. A., Budtz Pedersen, D., & Sutherland, W. J. (2023). AI tools as science policy advisers? The potential and the pitfalls. Nature, 622(7981), 27-30. https://doi.org/10.1038/d41586-023-02999-3

[15] Data-driven AI systems are, in general, based on historical data, and we usually have data only about things that used to be important in the past. As policy is often oriented towards the future, this bias towards the past is a potential limitation of data-driven AI and its use in anticipatory governance.

that policymakers need simple answers and do not have time nor sufficient interest in abstract thinking or reflection.

Embedding science in the complex policy decision-making landscape has therefore been argued to lead to 'post-normal' science. The methods of post-normal science become important when "facts are uncertain, values in dispute, stakes high, and decisions urgent".[16] Uncertainty and the lack of knowledge then become key considerations for S4P. Whereas traditional views of S4P emphasised the objectivity, neutrality, and impartiality of scientific evidence, post-normal science starts from the claim that uncertainty and diverging values are unavoidable starting points for S4P. Instead of final truths, post-normal science aims to provide reasonable advice that takes into account multiple (potentially incompatible) views.

In Belgium, the S4Policy Programme of BELSPO differentiates what it calls "flash research" from "policy-driven" research.[17] The former is characterised by an urgent need to provide research-informed knowledge, based on the expressed needs of one or more federal public services or ministers. Policy-driven research, in contrast, aims to support the concerned departments or government in the implementation and management of their public policies. The topics for policy-driven research are identified at the beginning and in the mid-term of each legislature. Based on the identified research priorities and topics, a call agenda is established, and the information is submitted to the government as part of the budget cycle. The long-term strategic research calendar is reviewed annually by BELSPO and the S4Policy Programme Committee, and then adapted where necessary. This Programme is complemented by BELSPO's policy-for-science (P4Science) initiative, which defines and funds research on priority areas for science and innovation.

The BELSPO S4Policy Programme is strongly driven by the needs and priorities of the policy developers and implementors. Therefore, policymakers' views on the future are critically important. Some participants highlighted the relevance of knowledge produced in foresight activities under S4P, as hence the need to link future S4P activities to such activities. In Spain, for example, the recently launched National Office of Science Advice (*Oficina Nacional de Asesoramiento Cientifico, ONAC*) is located under the General Secretariat for Public Policy, European Affairs and Strategic Foresight, under the Presidency of the Government.

Knowledge about the future is a special challenge for S4P. The future does not exist, and positivist philosophers would therefore claim that we cannot have knowledge about it. Yet, all human action is oriented towards expected futures. Foresight processes, therefore, can be understood to produce those knowledge structures that make evidence possible and pertinent. Images of the future define what we can see as an opportunity and a challenge, and thus underpin our decisions. Knowledge about the future, therefore, paradoxically, is also the foundation for S4P.

One way to unpack all this is to move from common, future-oriented claims towards analysing the narrative framings and metaphors that underpin our thinking about different futures. Policy problems and solutions, for instance, have been shown to depend on the metaphors that are used to interpret them.[18] In foresight, this is often done using the method of Causal Layered Analysis.[19] This type of analysis moves from the surface-level "litany" towards the underpinning causal models, discourses that make these models salient, and metaphors that

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[16] Funtowicz, Silvio O., and Jerome R. Ravetz. 1993. 'Science for the Post-Normal Age'. Futures 25 (7): 739-55. https://doi.org/10.1016/0016-3287(93)90022-L

[17] https://www.belspo.be/belspo/P4Science-S4Policy/S4Policy_program_en.stm

[18] Lakoff, G. 1996. *Moral Politics: What Conservatives Know That Liberals Don't*. Chicago, IL: The University of Chicago Press.

[19] Inayatullah, S. 1998. 'Causal Layered Analysis: Poststructuralism as Method'. *Futures* 30 (8): 815-29. https://doi.org/10.1016/S0016-3287(98)00086-X

drive the narratives. Causal Layered Analysis can therefore, for example, be used to find alternative framings for policy challenges, thus making new types of scientific information and knowledge relevant for policymaking.

The Flemish Government set up in 2021 a Strategic Insights and Analysis (SIA) unit to improve its foresight capacity. It has organised S4P dialogues to explore long-term trends in priority policy areas for Flanders. The importance of integrating foresight in policymaking was also highlighted in a recent OECD study on the Flemish strategic foresight system.[20] It, however, also pointed out that much of the competences and initiatives remain fragmented, and anticipatory capacity in administration remains isolated in pockets of expertise.

In the S4P knowledge-creation and -sharing ecosystem, anticipatory knowledge production can, therefore, mean two very different things. Given specific expected futures, it is possible to create strategic agendas for research that build knowledge and capability in those areas. Such a top-down approach is often preferred by administrations that must prioritise and manage potentially very complex initiatives. On the other hand, it is also possible to build capacity for anticipation itself. The latter has specifically been the focus in anticipatory governance and future literacy initiatives.[21]

Preparing for the uncertain and unpredictable future typically leads to a shift from traditional problem-solving and decision-making towards knowledge co-creation and co-design. This shift is clearly seen, for example, in the Circular Flanders initiative discussed in more detail below. The academic and theoretical work at the CE-Center on circular economy plays a key role in this broader sensemaking process. It defines methodologies and indicators that turn the values and expectations of the participants into operational coordinates that help them to see their paths and current location on the circular economy landscape. This also allows them to define and discuss future targets. In the scenario work within the Centre, the circular economy landscape is put in the broader foresight-informed context, which feeds back to the methodological work, potentially allowing critical reflection on its assumptions.

Participants in the country visit noted that in a complex and potentially unpredictable world, complexity needs to be embraced, and sensemaking often becomes more important than decision-making. The ways in which we view the future largely define how we see opportunities and challenges. Knowledge of the future – or more accurately knowing how we know the future – may therefore be a central challenge for S4P.

3.2. Towards an ecosystem model

The second day of the meeting started with breakout group reflections on the knowledge-based view on S4P, and whether discussion on this in the previous day had changed participants' thinking about S4P.

The shift from a linear towards a more complex, dialogue-based and co-creative approach was confirmed by several participants. In particular, the ecosystem mapping and development projects with the JRC have highlighted the need to move beyond a linear model of S4P. It was, however, also noted that the focus in S4P is still very much on policy briefs, reports, and codified knowledge, and it would be important to reflect more on tacit and social aspects of knowledge. The linear S4P model has now become a much more complex

[20] OECD (2024). *The Strategic Foresight System of the Government of Flanders, Belgium*. Paris: Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/governance/the-strategic-foresight-system-of-the-government-of-flanders-belgium_e55125c5-en

[21] Miller, R. (Ed.). (2018). Transforming the Future: Anticipation in the 21st Century. Routledge / UNESCO. https://digitallibrary.un.org/record/1494609

ecosystem of interacting actors, but it was noted that policymakers would also need a richer understanding of knowledge flows and knowledge creation in S4P. The need for clear maps of S4P ecosystems was emphasised, so that the underpinning knowledge processes could be better fostered, and the roles of different ecosystem actors made clearer. At the same time, it was noted that – although some participating countries already have advanced S4P ecosystem architectures – the challenges in S4P are very similar across the participating countries. This raised, for example, the question as to what extent S4P ecosystems should be understood as national ecosystems, or whether a European or more international perspective could be useful or necessary.

3.2.1. Actors in the S4P ecosystem

The complexity of S4P ecosystems is illustrated by the Flemish youth policy ecosystem. A central “boundary object” that links the activities of ecosystem actors is the Youth Policy Plan. Several organisations provide inputs that are used to shape the plan and define its focus areas. At the same time, participating organisations also gain a better understanding of research needs and policy priorities. The organisations involved in developing the Youth Plan are themselves network aggregators. The ecosystem could also be described as a “network of networks”.

The main actors and knowledge flows involved in this specific example are depicted in the figure below.

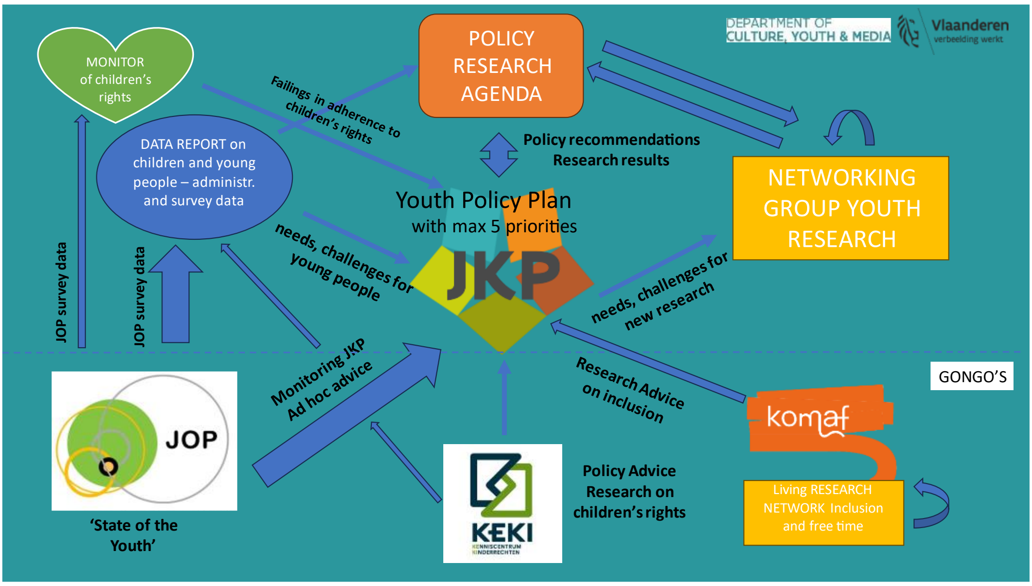

Figure 2: Explicit knowledge flows in the Flemish Youth Policy Plan system

In the Flemish youth knowledge ecosystem, JOP (the youth research platform *Jeugdonderzoeksplatform*) plays an important role in collecting an inventory of youth-related empirical research on Flemish and Belgian youth. JOP was set up by the Flemish government in 2003 as a collaboration between the universities of Ghent, Leuven, and Brussels, to increase research on youth, reduce fragmentation, and improve policy communication.[22] The inventory includes a diverse range of research domains relevant for youth research, such as family, leisure, school, health, well-being, work, education, environment, delinquency, and

[22] https://jeugdonderzoeksplatform.be/en/

media. The main findings of these studies are summarised in short research files that are freely accessible for researchers, policymakers, students and other interested parties via the JOP website. Every five years, JOP conducts a survey, the JOP-monitor, which provides cross-sectional data based on a random sample of the Flemish youth population. JOP also collects data through city-level surveys that are targeted at secondary school students. JOP links the Flemish youth research ecosystem to the international ecosystem through the European Centre for Youth Policy (ECYP), and its researchers also actively publish research and participate in international conferences.

In the ecosystem, KeKi (the children's rights knowledge centre or *Kenniscentrum Kinderrechten*), provides policy advice related to children's rights, and it works with researchers to communicate science to policymakers.[23] KeKi is also one of the participants in Komaf, which focuses on training and awareness-raising on diversity, inclusion, and equity in the youth sector. Komaf is also an intermediary towards the youth service practitioners, and it has built a network of local youth work organisations and those with expertise in inclusion and diversity. It shares good practices and knowledge on youth inclusion and diversity through its website.[24]

Part of the ecosystem is the 'Research network on children and young people in Flanders'. Within this network group, the Department of Culture, Youth and Media informally coordinates with youth researchers, colleagues from other policy areas, and actors in the field. Knowledge is exchanged about ongoing and completed research, but also about interesting methodologies for research with children and young people, and about valorising and disseminating the findings. The network group organises two meetings every year for anyone interested in youth research.

Based on registry and survey data, the Department of Culture, Youth and Media also produces the Children's Rights Monitor. It provides data on children's living conditions and experiences and maps the context at different policy levels. The new 2.0 version of the Children's Rights Monitor is developed using a co-creative and participatory approach in which government, civil society, research and other stakeholders work together to populate and strengthen the instrument.[25] The Monitor also provides data for the UN Committee on the Rights of the Child and links the Flemish youth ecosystem to the international S4P ecosystem.

3.2.2. Complexity, uncertainty, and unpredictability in S4P

3.2.2.1. S4P ecosystems are complex

As the Flemish youth S4P example illustrates, ecosystems involve actors that have their own objectives and specialities. The essence of an ecosystem is that there are synergies and mutual dependencies among these actors. From a systems point of view, this makes such ecosystems reflexive and not only complicated but deeply complex.[26] The entities themselves are often collaborative units set up by existing organisations and complemented by loosely defined informal networks that bring stakeholders together.

[23] https://keki.be
[24] https://www.komaf.be
[25] https://www.vlaanderen.be/cjm/nl/jeugd/vlaams-jeugd-en-kinderrechtenbeleid/kinderrechten/kinderrechtenmonitor
[26] This type of complexity is often called Rosennean complexity, c.f., Louie, A. H., & Poli, R. (2017). Complex Systems. In R. Poli (Ed.), Handbook of Anticipation (1-19). https://doi.org/10.1007/978-3-319-31737-3_3-1

S4P ecosystems are complex and complicated also in very practical terms. For example, a recent study on the Spanish S4P ecosystem found almost 400 bodies within the General State Administration that perform consultative and advisory functions for the ministries.[27]

In the case of the Flemish youth S4P system, an important coordination tool is the JKP youth policy plan constructed jointly by the participating actors, using the knowledge and expertise they each developed. In shaping the JKP, the participants learn about the interests and needs of the ecosystem actors, and their interactions facilitate social learning and transfer of tacit knowledge that would be difficult or impossible to share purely based on data or written documents. Such informational interfaces can be understood as boundary objects, and these will be discussed further below as they are an important knowledge management concept also for S4P.

3.2.2.2. Policy problems are complex

Socially and politically important problems are often multifaceted, relate to many stakeholders with different priorities, and are inherently complex. Calling them problems may be misleading as it is not always clear that a solution would exist. Instead of a 'solution' the best outcome would be signs of improvement on the current situation, but a key challenge is to understand the current situation and define what progress would look like.

To address these questions in complex problem domains, the need for multidisciplinary research was emphasised by many of the participants. An illustrative example was provided by the Flemish CE-Center, which is part of the Circular Flanders hub. Circular Flanders was set up in 2017 by the Flemish Government, with the aim of making this Belgian region a trend-setter in the circular economy by decoupling economic growth from material consumption.

Circular Flanders works on six themed strategic agendas. Its steering group consists of the Flemish Minister of Environment and the Flemish Minister of Economy and Innovation as well as relevant sectoral federations, research institutes, and VVSG (association of Flemish cities and municipalities). The steering group reflects the 'social pentagon', including government, industry and business, local and social profit, knowledge institutions, and the financial world. The governance structure of Circular Flanders is shown in the figure below.

[27] Melchor, L., Cañibano, C., Krieger, K., & Real-Dato, J. (2024). The Spanish scientific and technical advisory ecosystem for public policy: Final discussion paper. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/452411

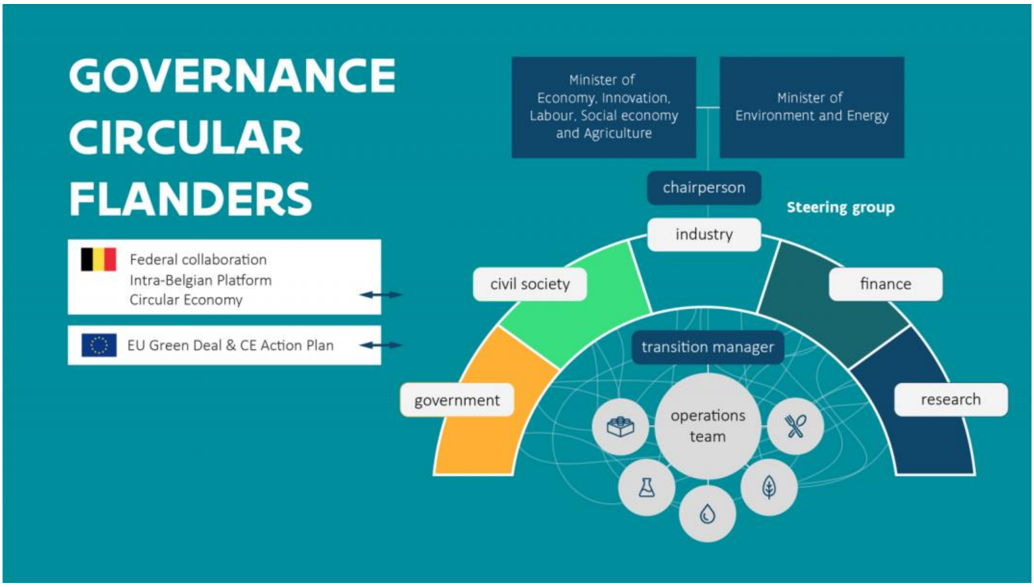

Figure 3: The ‘social pentagon’ in Circular Flanders

The CE-Center is the research hub for the Circular Flanders. It is co-funded by OVAM, the public waste agency of Flanders, and the Flemish Government, and it brings together researchers from four Flemish universities and the research organisation VITO. The CE-Center also links the circular economy ecosystem to the international research community. It has developed indicators and related frameworks for the circular economy and studied its potential impact on the labour market and material flows, including biomass, plastics, and CO2, and the impact of the circular economy on mobility.

One of its key outputs has been the Flanders Circular Economy Monitor that collects CE data on over 100 indicators. Beyond mapping the current state of the circular economy, the Center has also proposed key targets that help policymakers to see how they are progressing towards various objectives. At present, the Center focuses on five clusters of research. These include the further development of indicators for the CE-Monitor, research on socio-economic effects of the circular economy, legal bottlenecks, and behavioural aspects of the circular economy. The Center also conducts quantitative analysis of alternative scenarios.

The CE-Center thus addresses complex circular economy problems by bringing together different and complementary research competences working in the same domain. The focus on a shared generic problem, the circular economy, potentially facilitates the emergence of a new ‘community of practice’. This community, however, is itself a complex group of collaborators that come from different scientific disciplines, such as bio-engineering, environmental economics, city planning, strategic management, climate politics, environmental science, materials management, and law, among others.

The CE-Monitor could, therefore, be understood as an informational boundary object that facilitates cooperation across traditional disciplinary boundaries. It could also be understood more widely as a so-called “boundary organisation” loosely connecting and coupling organisational systems with very different logics and time horizons. Interestingly, the Monitor also links policymakers to the Center’s activities by providing quantifiable targets and measures of progress for policy. Although the circular economy obviously is a deeply complex system, the indicators defined by the Center observe important characteristics of this system and provide data about its state. The generation of facts and evidence occurs, therefore, in the same way as in empirical sciences. The difference is that as the system is deeply complex, the generated evidence cannot, in general, be used to predict the future of the system.

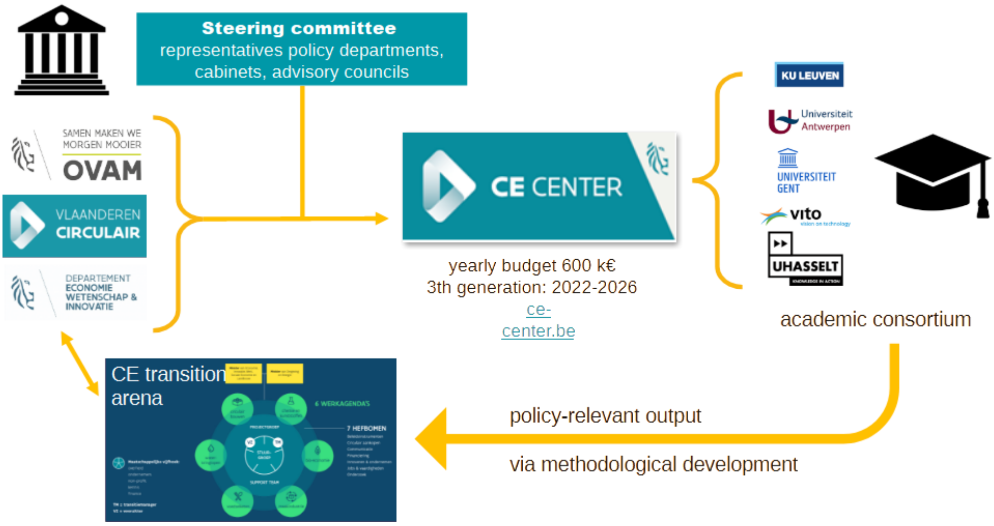

Figure 4: Stakeholders of the Circular Flanders CE-Centre

4. Managing knowledge in S4P: key concepts

4.1. The importance of tacit knowing

Research on knowledge-sharing among scientists has highlighted the importance of social networks and personal communication. For example, often even the most detailed scientific documents are not sufficient for other scientists to reproduce experimental results, and personal interaction is needed. Nonaka's work on innovation and knowledge-creation provided a new perspective on this when he highlighted the importance of tacit knowledge as the key ingredient in organisational learning and innovation.[28] As a result, data, information, and explicit knowledge are now understood to be only the tip of the knowledge iceberg. This has fundamental implications also for S4P.

Nonaka's SECI-model (see the figure below) separated four different stages in the knowledge-creation processes: socialisation, externalisation, combination, and internalisation. In this model, unarticulated tacit knowledge is shared by observation and social participation and converted and "externalised" as explicit knowledge, such as written plans and designs. Explicit knowledge is further combined with other sources of explicit knowledge, and eventually internalised again by individuals, groups and organisations as tacit knowledge that shapes their thinking and action.

[28] Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. Organization Science, 5(1), 14-37.

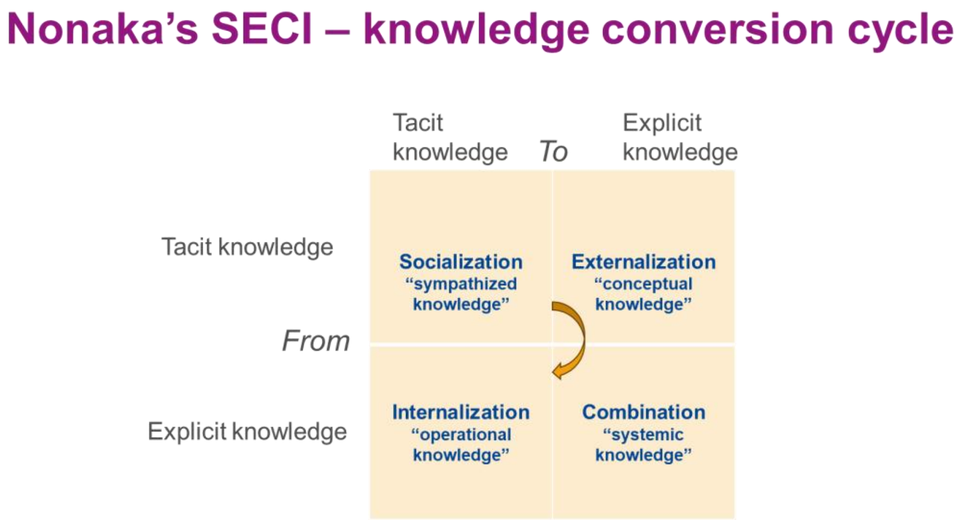

Figure 5: The SECI-model
Source: adapted from Tuomi, I. (1999) Corporate Knowledge, p. 325)

The SECI-model contrasted with influential earlier views that saw computers, databases, information architectures, and executive information systems as keys to organisational memory and knowledge management. Today, it is understood that information systems can only handle knowledge after it is made explicit, structured as information, and represented as data in a form that a computer can process.[29]

Knowledge is constructed and interpreted in fundamentally social processes. Management of knowledge, therefore, is not only about sorting information and evidence, it is about managing those social processes that make information and knowledge meaningful. This has allowed researchers and managers to ask how these processes should be organised and facilitated.

At the same time, it has been recognised that knowledge often flows in informal social networks that may be invisible for planners and managers. Managerial theories about how knowledge is and should be shared rarely reflect the practical reality. The implementation of such 'espoused' but inaccurate theories in organisations using information systems often has unexpected negative consequences. This has led to extensive research on the actual knowledge processes in organisations, often using ethnographic and anthropological approaches.

Whereas S4P has sometimes been understood as a problem of providing scientific evidence and data for the use of policymakers, today it is therefore widely viewed as a problem of knowledge management. Both science and policymaking can be understood as complex knowledge systems. S4P then becomes a challenge of managing knowledge in this framework and connecting often very different 'systems of knowing'. Instead of translating information from one system to another, deeper integration and interpretation is needed.

[29] Tuomi, I. (1999). Data is more than knowledge: Implications of the Reversed Knowledge Hierarchy for knowledge management and organizational memory. *Journal of Management Information Systems*, 16(3), 103-117. https://doi.org/10.1080/07421222.1999.11518258.

For example, the BELSPO S4Policy Programme Committee includes a 'transversal expert' who is not a member of the Federal Council for Science Policy or a representative of the Federal Services but an expert in S4P and its knowledge demands. Such a role can be understood as a facilitator, an interpreter, or a 'boundary individual'. Instead of network 'bridges' studied in social network research, such a person not only moves knowledge from one part of the network to another but actively participates in its co-construction. The need for competent expert facilitators in S4P was also noted by participants in country visit.

Tacit knowledge is often contextual and assumed to be known. In the original sense proposed by Polanyi,[30] knowledge consists of tacit and explicit components that cannot be separated because the tacit background provides the context that makes explicit knowledge meaningful. The learning of this tacit component of knowing, therefore, requires participation and observation.

In S4P, the need to learn tacit knowledge has often been addressed by personal mobility, secondments, and job rotation. An example is the Innoviris Applied PhD programme in the Brussels-Capital region.[31] In this programme, a doctoral student can work on a thesis that has strong relevance to the administration's interests, and where the outcomes of research can be valorised within the administration. The requirement is that at least half of the researcher's time is spent on-site in the administration. The academic institution where the student is enrolled is fully funded by Innoviris to cover the costs of the PhD.

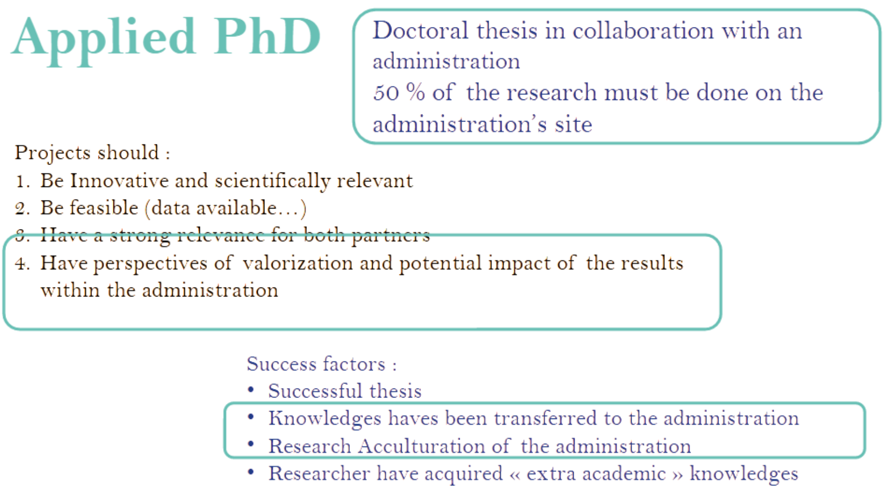

Figure 6: Innoviris Applied PhD

Embedded facilitators and interpreters may also be needed because scientific advice may concern sensitive policy areas. Participants observed that there can be restrictions on disclosing the information discussed. It was duly noted: "You are either inside the room, or outside!" Whereas research itself is moving towards open science, the interpretation of its implications for policy may require limiting transparency. The need to limit transparency can sometimes be understood as the impossibility to move the tacit component of knowing beyond the site where dialogue, discussion, and learning happens. Lack of transparency

[30] Polanyi, M. (1962). Personal Knowledge: Towards a Post-Critical Philosophy.
[31] https://innoviris.brussels/program/applied-phd

often emerges simply because explicit knowledge is easily misunderstood without proper context.

The success of exchanges, internships, and secondments often depends on personal characteristics. In the Wallonia-Brussels Federation, the Observatory of Research and Scientific Carriers (*L'Observatoire de la Reserche et des Carrières Scientifiques)* produces data on doctoral students and their post-doctoral careers.[32] The Observatory has emphasised the importance of non-academic transversal teamwork and collaboration skills that are not adequately developed in academic training. Whereas the Observatory focuses on researchers, similar needs were also noted in administration.

The key points to consider and sample S4P instruments that facilitate the creation and sharing of tacit knowledge are shown in the table below.

Key points: • Knowledge includes tacit and explicit components. Only what is made explicit can be communicated in verbal or textual format or stored in databases. • Explicit knowledge is always partial knowledge. To make sense of explicit knowledge, tacit knowledge is needed. • Tacit knowledge is learned in observation and social interaction.
S4P instruments that address this: • Staff exchanges, pairing schemes, internships, and secondments. • Communities of practice. • S4P dialogues.

Table 1: Key points and instruments for the tacit component of knowing/knowledge

4.2. Communities of thought and practice

Lave and Wenger developed the Community of Practice (CoP) concept by linking ethnographic and anthropological studies with the cultural-historical theory of learning.[33] According to Lave and Wenger, a CoP is oriented towards specific social practices, different knowledge communities have different ways of knowing the world, and members of these practices gain identity and competence by becoming members of the community.

[32] https://observatoire.frs-fnrs.be/

[33] Lave, J., & Wenger, E. (1991). Situated Learning: Legitimate Peripheral Participation. Cambridge University Press. The concept became influential in knowledge management through the parallel work by J.S. Brown and Paul Duguid, e.g., Brown, J. S., & Duguid, P. (1991). Organizational learning and communities of practice: Toward a unified view of working, learning, and innovation. Organization Science, 2(1), 40-57.

In the concept of CoP, three things are focal. First, a CoP is the unit where socially important forms of learning occur. A CoP is a model of social learning and a theory about community-specific epistemology. CoP is the underlying social structure that allows novices to become competent members and masters of a practice as they internalise community-specific tacit and explicit knowledge, and thus gain community-related experience. Second, communities are defined as communities of social practice. Learning that occurs in a CoP is situated in a practical context where the appropriate use of tools, methods, techniques, and procedures defines the level of competence. The CoP model, therefore, is also one of 'situated learning'. Third, the members of the community define their identities as members of the community. Although people in modern societies have many identities and can be members in many CoPs simultaneously, as members they share the systems of meaning that make the community a 'social unit'.

To use an alternative term, a CoP is an 'epistemic community'. It has a shared worldview and a set of core concepts and values that organise the world. Within the community the shared worldview enables forms of argumentation, evidence, and causal explanation. Different epistemic communities, however, often have conflicting views about evidence and its relevance.

Early conceptualisations of science-policy interfaces sometimes adopted a rather idealistic model of science as a collective effort to find 'scientific truths'. In science and technology studies, however, the importance of alternative worldviews has been a central topic. The groundbreaking studies by Ludwik Fleck[34] showed that the facts and evidence produced by one scientific community may be fiercely rejected by another community. Fleck defined a "thought collective" as a community of persons mutually exchanging ideas or maintaining intellectual interaction. Members of the collective not only adopt certain ways of perceiving and thinking – a 'thought style' – but they also continually transform it. Some thought collectives are short-lived, while others may become institutionalised.[35]

Importantly, in technology studies it has been pointed out that communities of practitioners do not only share knowledge but also systems of values that enable participants to define what counts as improvement.[36] CoPs and epistemic communities, therefore, are not only knowledge communities: they also have different value systems. More broadly, these have also been called "epistemic cultures" in science.[37] What is considered relevant and what counts as a fact depends on the community in question.

In practical terms, this suggests that scientific evidence cannot always be generated using methods that aim for consensus. For example, the widely used Delphi-method was designed to support policymaking by finding consensus among experts. If scientific stakeholders have incompatible worldviews, it may be useful to think how the energy from conflict can be harvested and turned into productive collaboration. In science, facts are often contested because they emerge in knowledge systems that are based on different theoretical frameworks, core assumptions, and inquiry practices. Instead of looking for universal facts that scientists could agree upon, the plurality of knowledge systems can also be understood as the key resource for S4P.

[34] Fleck, L. 1979. Genesis and Development of a Scientific Fact. Chicago, IL: The University of Chicago Press.

[35] Douglas, M. (1987). How Institutions Think. Routledge & Kegan Paul.

[36] Constant, E. W. (1987). The social locus of technological practice: Community, system, or organization? In W. E. Bijker, T. P. Hughes, & T. J. Pinch (Eds.), The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology (223-242). The MIT Press.

[37] Knorr Cetina, K. (1999). Epistemic Cultures: How the Sciences Make Knowledge. Harvard University Press.

In the Leuven meeting it was noted that sometimes policymakers need knowledge on a specific topic and only one community is involved in its creation. This could be the case, for example, when there is a well-specified need and a simple answer is required. In more anticipatory settings, where the problem itself needs to be articulated, a plurality of views is unavoidable. Perhaps a useful starting point is to recognise that science, in general, cannot directly provide answers to policy challenges; instead, it provides evidence-based points of view that must be integrated and formulated into policy- and decision-making processes. Actionable knowledge, in this view, is something that policymakers must make, not something that scientists produce. This requires capacity development in intermediary organisations and on the policymaker side of the ecosystem, as participants noted.

Whereas much research has focused on scientific communities and their worldviews, policy communities also have their own practices and understandings of the world. The ‘science-policy boundary’, therefore, consists of multiple interfaces between such communities. S4P ecosystems contain various types of actors, but from an epistemic point of view it is important to note that they also have their own systems of knowledge.

The community-based view on knowledge-creation and -sharing has become extremely influential in contemporary organisational theory and practice. Often, however, it has been realised that it is difficult to ‘set up’ CoPs by fiat. A CoP is a social entity and does not emerge simply by labelling a group of people as such. It is important to understand that some groups are set up so that various bodies of knowledge can be integrated, and a problem can be solved. These are often best understood as project teams. Other types of groups underpin the development of expertise and stable bodies of knowledge. Some knowledge communities are short-lived and transient, whereas others are institutionalised.

In innovation research, it has been recognised that knowledge which flows across ‘knowledge communities’ also depends on the historical development of these communities. Two very different kinds of knowledge-creation processes result from community interactions if the communities in question are spin-offs from the same parent or if the communities integrate knowledge rooted in independent communities. This is important to note when knowledge-sharing networks and communities are intentionally created as S4P instruments.

In the former case, the communities share important elements of their value systems and conceptual frameworks, whereas in the latter, the value systems and epistemologies can be different and incompatible.[38] In the latter case, mutual learning may call for more than a simple ‘informing’ process; it is a political exchange or interaction where different perspectives and viewpoints are negotiated.

The concept of CoP, therefore, can be a very useful starting point in understanding and organising knowledge-sharing, but there needs to be clarity about what kind of a community is being discussed. In ‘designing’ communities for knowledge-sharing, it is important to think whether they are intended to combine different domains of knowing or accelerate learning within an existing CoP.

The key points to consider and sample S4P instruments that facilitate the creation and development of CoPs are shown in the table below.

[38] Tuomi, I. (2002). Networks of Innovation. Oxford University Press.

Key points:

- Scientific facts emerge within ‘communities of thought’ and ‘epistemic cultures.’ Different communities can have incompatible views of the world and different value systems.
- Scientific evidence is always contestable and uncertain.
- Science and policy communities have complex interfaces.

S4P instruments that address this:

- Multi-disciplinary scientific advice.
- Knowledge brokers.
- S4P competence centres.

Table 2: Key points and instruments for communities of scientific and policy practice

4.3. Crossing epistemic boundaries

4.3.1. Boundary objects and information infrastructures

If knowledge is learned, constructed and created in communities, an important question is how **different** communities can share knowledge. The epistemology of CoPs implies that knowledge becomes meaningful when it is interpreted in the context of tools and practices that are specific to the community in question. In contrast to the empiricist belief that scientific facts are universal and independent of local interpretation, knowledge is increasingly understood to be culture-specific, situated, and practice-related. To the extent that the facts of ‘hard’ sciences are reproducible, this is made possible because the researchers in the discipline rely on culturally accumulated concepts, organised into commonly accepted models, methods and tools for observation which are shared within the scientific community in question.

One important idea that addresses this challenge is the concept of a ‘boundary object’. Leigh Star introduced it originally in the context of distributed artificial intelligence, based on her research on scientific communities and problem-solving in the face of conflicting interests.[39] Star emphasised the nature of scientific communities and workplaces as open systems, where multiple viewpoints and knowledge are continuously evolving.

Each actor, site, or node of a scientific community has a viewpoint, a partial truth consisting of beliefs, local practices, constraints, and resources – none of which are fully verifiable across all sites. The robustness of scientific results comes from the aggregation of those viewpoints. A boundary object is the potentially multifaceted interface that links communities of knowing and stabilises the structure of truths.

[39] Star, S. L. (1989). The Structure of Ill-Structured Solutions: Boundary Objects and Heterogeneous Distributed Problem Solving. In Les Gasser & Michael N. Huhns (Eds.), Distributed Artificial Intelligence (37-54). Morgan Kaufmann.

Boundary objects can be simple plans, (road)maps, designs or documents, but they can also be systems of categorisation, classification, taxonomies, and typologies. To become information, knowledge needs to be fitted into existing categories. Science, therefore, crucially depends on the structure of these informational infrastructures.

Star and Bowker,[40] in particular, have emphasised the point that computer-based information systems have become vital infrastructures for implementing social categorisations. In the modern information society, system designers are important decision-makers who often unintentionally determine what can be considered 'known'.

Boundary objects are often artifacts that couple or match up activities performed by multiple ecosystem actors. The participants also noted that 'boundary organisations' in S4P play a similar role. In many countries, the communication in S4P systems is facilitated by special organisations, such as the recently created National Office of Scientific Advice in Spain. Policy-oriented research consultancies also act as boundary intermediaries because they typically have the capacity to react to policy knowledge needs that are difficult to address in the science system, where research resources often have to be committed for longer time periods.

The need to create new arenas for S4P dialogue was noted by the meeting participants. It was, however, also suggested that – instead of creating new organisations and structures – existing structures could be repurposed and enhanced so that they better address the needs of effective S4P.

The key points to consider and sample S4P instruments that can couple epistemic communities are shown in the table below.

Key points: • Collaboration is possible without consensus. • Policy and science communities are often linked by information artifacts and infrastructures that enable and constrain the type of knowledge that moves across boundaries.
S4P instruments that address this: • Road-mapping, technology plans, and joint programming. • Boundary organisations and intermediaries.

Table 3: Key points and instruments for boundary objects and information infrastructures

[40] Bowker, G., & Star, S. L. (1999). Sorting Things Out: Classification and its Consequences. The MIT Press.

4.4. ‘Downstream’ as a focus of knowledge creation

Throughout the meeting, the importance of co-creation, participation, and dialogue was emphasised by participants.

In the multifocal innovation model,[41] several ‘downstream’ communities of practice try and make sense of the emergent and often latent functionalities of new technologies. Those communities that are able to integrate new technology in their practices define what the technology is and what it means. Instead of ‘diffusion’ of innovations, the process therefore is about active construction of knowledge and social learning in the context of prevailing social practices. Furthermore, the various potential user communities often have conflicting interests about the future development of a technology in question.

In S4P contexts, a similar process underpins the diffusion of knowledge. Again, multifocal models highlight the point that there are many downstream policy communities as potential users of research-produced evidence. In general, downstream innovation models emphasise the active effort of information users in knowledge-creation. As discussed above, this is in clear contrast to earlier models that focused on the ‘diffusion’ of innovation and knowledge from ‘up-stream’ producers to end-users. In the context of S4P, it also suggests a shift towards downstream processes that turn knowledge into policy change. Such a shift raises questions about learning processes in policy communities, as well as instruments that increase their absorptive capacity for new knowledge.

In concrete terms, one may ask what it takes for policymakers to be able to learn and make sense of research-based evidence. Downstream innovation models suggest that the question is not only about individual capacity but perhaps, more importantly, about systemic capacity for change. Policy experiments and learning are examples of instruments that focus on downstream knowledge-creation.

Shifting the focus on downstream knowledge-creation processes also highlights the importance of capacity development and absorption. For example, the Finnish Innovation Fund (Sitra) has for many years organised training for new legislators in areas that are of strategic importance for policy. Such capacity-building is useful, but also needs to be supported by structures and processes. As the meeting participants noted, sometimes it is practical to repurpose existing institutions, adjusting processes and structures as needed to achieve this. The prevailing S4P ecosystems are products of history, and their actors are not necessarily optimised for co-creation and extensive interaction among the various stakeholders. As the public administrations in many countries face economic pressures and downsizing, ecosystem development thus faces important challenges.

The key points to consider and examples of S4P instruments and approaches that integrate downstream policy knowledge in the S4P process, are shown in the table below.

[41] C.f. Tuomi, I. (2012). Foresight in an unpredictable world. Technology Analysis & Strategic Management, 24(8), 735-751.

Key points: • Information becomes meaningful when user communities make sense of it in their practical and epistemic context. • Social learning in ‘downstream’ communities is the source of impact. • S4P instruments that generate absorptive capacity in policy communities are important for impact.
S4P instruments that address this: • Policy co-design and co-creation. • Transparency, open access, and open science.

Table 4: Key points and instruments for information use, social learning, and impact in S4P

5. Conclusions and recommendations

Knowledge is the foundation and a key driver of science-for-policy or ‘S4P’. To design and implement S4P instruments, it is therefore important to understand how knowledge is created, how it flows in social networks and communities, and how people and organisations learn to make sense of it. This first Thematic Report for the Mutual Learning Exercise on Bridging the Gap Between Science and Policy has therefore focused on a knowledge-based view of S4P. Many of the concepts discussed in this Report have emerged in the context of organisational innovation and learning, but they are fundamentally relevant and useful also for S4P. This Report, therefore, aligns with ‘S4P 2.0’ developments, as proposed by the European Commission’s Joint Research Centre, also suggesting some possible directions for further development.

The Report is partly based on ideas introduced in the Discussion Paper prepared for the first MLE meeting in Leuven. More importantly, it reflects upon the rich participant discussions and presentations during the MLE meeting. At the same time, the Report has also tried to help the MLE build a firm conceptual foundation, thus discussing the scope and nature of S4P as it emerges in the knowledge-based framework.

The shift from what has been described as an “old-school” approach in S4P towards a learning-oriented and more constructivist models, highlights the importance of policymakers as knowledge-creators in the S4P process. This suggests that downstream capacity development is a central challenge for S4P. This Report has highlighted the need to support co-creation and new arenas for dialogue as important capacity-building tools to integrate high-quality research outputs into the policy process.

Scientific knowledge enters policy processes as one of the elements in a broader knowledge-for-policy or K4P ecosystem. Rigorous scientific knowledge becomes meaningful for policymakers in this broader K4P system. The downstream knowledge-creation processes by policymakers are critically important for S4P impact and should be explicitly considered in

S4P development. When S4P ecosystems are mapped and their actors defined, S4P should also be located in this broader K4P ecosystem. This is particularly important as science itself is changing, commercial research produces policy-relevant evidence in many societally important domains, and new knowledge infrastructures, such as social media and generative AI models, question and transform expertise.

In the old-school, linear S4P approach, scientific advice was often understood as the ‘disinterested’ provision of objective evidence for policymakers to use as needed. In a knowledge-based approach to S4P, scientific advice focuses on helping policymakers make sense of the evidence in the process of creating useful ‘knowledge’. Science advisors, therefore, also need to understand key knowledge management concepts and their relevance to policy advice.

Knowledge always has a tacit component that provides the interpretative framing for explicit knowledge. Increasing the amount of explicit knowledge is rarely useful for S4P unless it is accompanied by processes for sharing the (tacit) context. S4P instruments that enable knowledge co-creation allow actors or those involved to share tacit contexts that are often impossible to fully convert into explicit knowledge. Scientific evidence can be used for problem-solving and decision-making, but effective integration of scientific knowledge can often redefine and reframe the problem. Integrating multiple scientific perspectives and civic knowledge that underpins policy choices is a challenging task but should be addressed for effective S4P.

The impact of scientific advice clearly depends on policymakers’ capacity to make sense of or absorb the proffered advice. One practical way to increase absorptive capacity is to organise training for new policymakers on scientific developments in areas that have high policy relevance. Such training can also reduce common misunderstandings about S4P; for example, that science can provide the ‘right answer’ to complex social problems, or that S4P actors ‘neglect policy realities’.

The Report spells out that scientists and policymakers are participants in many communities of practice, each with their own ways of ‘knowing the world’. It introduces the idea of ‘boundary objects’ and ‘informational infrastructures’, which allow different communities to work together, and stresses that collaboration is possible without consensus.

Search for expert consensus easily reinforces currently dominant views. These reflect history, and often neglect new perspectives. When scientific advice is constructed, it is important to recognise that authoritative advice cannot be based on consensus but requires deliberation, argumentation, and productive conflict. This can be supported by creating forums where critical scientific debates on policy-relevant topics are encouraged across disciplines and by using such forums as sources of expertise.

Creating a conducive environment for this is by no means an easy task. The S4P knowledge landscape or ecosystem – structures, organisations, institutions, actors, etc. – is particularly complex and fragmented. Yet, as this Report has argued, trying to remove or avoid such complexity is futile; the best course of action is to fully embrace it. Policy challenges are themselves often complex and addressing them requires multiple perspectives and future-oriented thinking. In such a world, black and white ‘truths’ are rare, so the answer is learning. The present MLE is an illustrative example of how new knowledge can be productively created and shared.

References

Bowker, G. C., Timmermans, S., Clarke, A. E., & Balka, E. (Eds.). (2016). *Boundary Objects and Beyond: Working with Leigh Star*. MIT Press.

Bowker, G., & Star, S. L. (1999). *Sorting Things Out: Classification and its Consequences*. The MIT Press.

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities of practice: Toward a unified view of working, learning, and innovation. *Organization Science*, *2*(1), 40-57.

Council of the European Union. (2023, December 8). *Strengthening the role and impact of research and innovation in the policymaking process in the Union*.

Dotti, N. F. (2024). *Guidance on Science for Policy Activities: Principles, Actions, and Examples*. Science Europe. https://zenodo.org/doi/10.5281/zenodo.10911927

Douglas, M. (1987). *How Institutions Think*. Routledge & Kegan Paul.

EC. (2021). *Better regulation: Joining forces to make better laws*. https://commission.europa.eu/document/199176cf-6c4e-48ad-a9f7-9c1b31bbbd09_en

EC. (2022). *Supporting and connecting policymaking in the Member States with scientific research* (SWD(2022) 346 final). https://knowledge4policy.ec.europa.eu/file/staff-working-document-supporting-connecting-policymaking-member-states-scientific-research_en

Fleck, L. (1979). *Genesis and Development of a Scientific Fact*. The University of Chicago Press.

Funtowicz, S, and J. Ravetz. 1993. 'Science for the Post-Normal Age'. Futures 25 (7): 739-55. https://doi.org/10.1016/0016-3287(93)90022-L.

Geels, F. W. (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy*, *39*(4), 495–510. https://doi.org/10.1016/j.respol.2010.01.022

Guston, D. H. (2001). Toward a 'Best Practice' of Constructing 'Serviceable Truths'. In *Knowledge, Power, and Participation in Environmental Policy Analysis*. Routledge.

Inayatullah, S. (1998). 'Causal Layered Analysis: Poststructuralism as Method'. *Futures* 30 (8): 815-29. https://doi.org/10.1016/S0016-3287(98)00086-X.

Jasanoff, S. (2007). *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton University Press.

Joint Research Centre (European Commission), Melchor, L., Cañibano, C., Krieger, K., & Real-Dato, J. (2024). *The Spanish scientific and technical advisory ecosystem for public policy: Final discussion paper*. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/452411

Jørgensen, U. (2012). Mapping and navigating transitions – The multi-level perspective compared with arenas of development. *Research Policy*, *41*(6), 996-1010. https://doi.org/10.1016/j.respol.2012.03.001

Knorr Cetina, K. (1999). *Epistemic Cultures: How the Sciences Make Knowledge*. Harvard University Press.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press.

Lakoff, G. (1996). *Moral Politics: What Conservatives Know That Liberals Don't*. Chicago, IL: The University of Chicago Press.

Louie, A. H., & Poli, R. (2017). Complex Systems. In R. Poli (Ed.), *Handbook of Anticipation* (pp. 1–19). Springer International Publishing. https://doi.org/10.1007/978-3-319-31737-3_3-1

Miller, R. (Ed.). (2018). *Transforming the Future: Anticipation in the 21st Century*. Routledge / UNESCO. https://digitallibrary.un.org/record/1494609

Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, *5*(1), 14-37.

Nonaka, I., Toyama, R., & Hirata, T. (2008). *Managing Flow: A Process Theory of the Knowledge-Based Firm*. Palgrave Macmillan.

OECD. (2024). *The Strategic Foresight System of the Government of Flanders, Belgium*. Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/governance/the-strategic-foresight-system-of-the-government-of-flanders-belgium_e55125c5-en

Pedersen, D. B. (2023). *An evaluation framework for institutional capacity of science-for-policy ecosystems in EU Member States*. Publications Office of the European Union. https://doi.org/10.2760/609597

Polanyi, M. (1998). *Personal Knowledge: Towards a Post-Critical Philosophy*. Routledge.

SAPEA. (2019). *Making sense of science for policy under conditions of complexity and uncertainty*. Science Advice for Policy by European Academies. https://doi.org/10.26356/masos

Sarvaranta, L., Bravo-Biosca, A., De Marchi, B., Weber, M., Könnölä, T., & von Schomberg, R. (2023). *Futures of science for policy in Europe: Scenarios and policy implications*. Publications Office of the European Union. https://data.europa.eu/doi/10.2777/121857

Sohn, J. (2018). Navigating the politics of evidence-informed policymaking: Strategies of influential policy actors in Ontario. *Palgrave Communications*, *4*(1), 1-12. https://doi.org/10.1057/s41599-018-0098-4

Star, S. L. (1989). The Structure of Ill-Structured Solutions: Boundary Objects and Heterogeneous Distributed Problem Solving. In L. Gasser & M. N. Huhns (Eds.), *Distributed Artificial Intelligence* (37-54). Morgan Kaufmann. https://doi.org/10.1016/B978-1-55860-092-8.50006-X

Šucha, V., & Sienkiewicz, M. (2020). *Science for Policy Handbook*. Elsevier. https://shop.elsevier.com/books/science-for-policy-handbook/sucha/978-0-12-822596-7

Tuomi, I. (1999). Data is more than knowledge: Implications of the reversed knowledge hierarchy for knowledge management and organizational memory. *Journal of Management Information Systems*, *16*(3), 103-117. https://doi.org/10.1080/07421222.1999.11518258

Tuomi, I. (2002). *Networks of Innovation: Change and Meaning in the Age of the Internet*. Oxford University Press.

Tuomi, I. (2012). Foresight in an unpredictable world. *Technology Analysis & Strategic Management*, *24*(8), 735-751. https://doi.org/10.1080/09537325.2012.715476

Tyler, C., Akerlof, K. L., Allegra, A., Arnold, Z., Canino, H., Doornenbal, M. A., Goldstein, J. A., Budtz Pedersen, D., & Sutherland, W. J. (2023). AI tools as science policy advisers? The potential and the pitfalls. *Nature*, *622*(7981), 27-30. https://doi.org/10.1038/d41586-023-02999-3

Zolfagharian, M., Walrave, B., Raven, R., & Romme, A. G. L. (2019). Studying transitions: Past, present, and future. *Research Policy*, *48*(9), 103788. https://doi.org/10.1016/j.respol.2019.04.012

Appendix: Examples of discussion topics

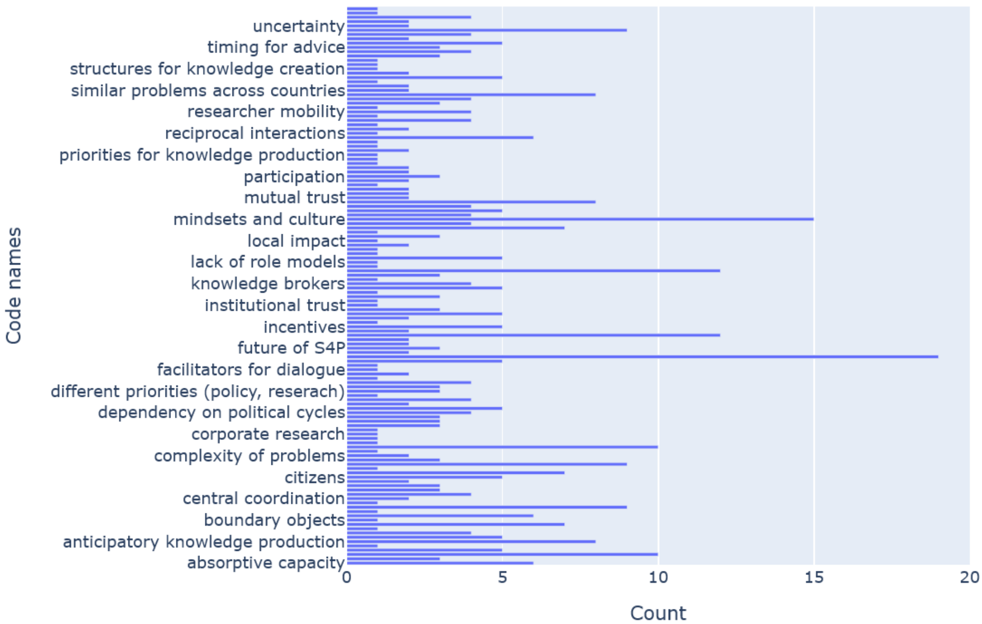

Figure 7: Exploratory ‘frequency counts’ of topics in the meeting minutes

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The European Commission launched a Mutual Learning Exercise on ‘Bridging the Gap Between Science and Policy’. This Thematic Report focuses on the first discussion topic about fostering knowledge-sharing within and among Science for Policy (S4P) actors. The report highlights the need to frame S4P in the broader context of knowledge-for-policy (K4P) and it introduces key knowledge management concepts for this. S4P can be understood as a learning and sensemaking process with many knowledge creators, and the report discusses ways in which the knowledge-based view can inform the development of S4P ecosystems and scientific policy advice.

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