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International Network for Governmental Science Advice

PRINCIPLES AND STRUCTURES OF SCIENCE ADVICE: AN OUTLINE

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INTRODUCTION

Science advice to inform policymaking at multiple scales has experienced a surge in interest and activity in recent years. Even before the COVID-19 pandemic shone a stark light on the processes by which national governments and the multi-lateral community obtain scientific knowledge for decision- making, there was a growing interest in the systems and processes of evidence development and expert interpretation. From both supply and demand perspectives, science advice for policy has come to be seen as both informing policy solutions and underpinning the public trust necessary to implement them successfully.

PRINCIPLES OF SCIENCE ADVICE

While formal processes of science advice emerged after the Second World War, their initial purpose tended to support national defense and security interests. Over time, science advice has come to support wider developmental and environmental interests through advice on understanding complex systems, social policy, data, technology, and innovation. There is a growing recognition of the need for science-policy interface mechanisms at regional and global scales to support collective action on issues of common concern as the interdependencies of complex policy issues are better understood.

It took some time for a clear distinction to emerge between science advice focusing on 'policy for science' and that which focuses on 'science for policy.' The former concentrates on managing the public research system through funding and infrastructure, while the latter focuses on providing scientific evidence to inform public policymaking on a wide range of issues and requires quite a broader, pluralistic, and indeed different skill set and approach.

The two distinctive components of science advice: evidence synthesis and knowledge brokerage

1. Evidence synthesis aims to establish the state of available knowledge on a given issue through a range of methods including literature reviews, scientific assessments, and expert inputs. Importantly it must consider the multiple disciplines and framings that should contribute knowledge to the question in hand.
2. Brokerage is understood as the interactive and iterative process of dialogue between science and policy to help structure policy problems, frame the related questions, communicate certainties and uncertainties of the science, and their implications in ways that are policy relevant but not policy prescriptive. Brokerage is essentially about bringing scientific evidence to bear by helping decision-makers to interpret scientific information, its meanings, implications, and limitations for the purpose of supporting their deliberations and decision- making.

Science advice brings together these two dimensions by providing evidence-based insights to support decision-making.

Furthermore, it is understood that science advice for evidence-informed public policy relies on the two key functions of evidence synthesis that seeks to establish the extent and limits of knowledge integrated across a broad range of disciplines at a given time, and knowledge brokerage that seeks to support decision-makers in interpreting evidence, drawing conclusions, and implementing the needed actions. However, in many countries, creating appropriate structures to perform these functions remains a challenge.

Yet, as countries develop science advice systems that respond to their specific institutional and socio- cultural contexts, there are nonetheless general principles that are emerging. Over the past few years, efforts by the ISC, INGSA, and others led to the development of a significant international community through which commonalities across multiple models of science advice for policy (as distinct from the advice for steering national R&D systems) could be identified. Many of these principles have been exemplified in diverse country settings and the recent shared experience of the pandemic and climate and biodiversity crises have added weight to their universality.

The following interrelated principles underpin science advice to policy across the broad spectrum of policy sectors:

1. **Independence**: Science advice should take the form of honest brokerage rather than advocacy (Pielke 2007, Gluckman 2021). This requires a level of independence from the policy-making apparatus to ensure trusted advice for evidence-informed policy. Such independence can manifest in the ability of the established science advice mechanism to organize its work within its overall mandate, the ability to look at issues on its own initiative, the appointment of advisors in their individual expert capacity, the use of data and evidence from multiple sources, etc.
2. **Legitimacy**: Science advice must be conscious of the need to maintain trust and legitimacy with multiple communities simultaneously; the political community, the policy community, the public and the science community. Building and maintaining trust and legitimacy will be aided by good public-facing communication on one hand. Science advisors and science advice mechanisms should strive for openness of their process and deliberations by default, as this principle also supports the others. Of course, in matters of security, full transparency may not always be possible. On the other hand, engaging a plurality of disciplines and knowledges (including input from non-scientific stakeholders) is desirable to inform the synthesis of evidence, using robust and transparent processes and generate knowledge that is actionable.
3. **Relevance and access**: To be effective the advisory system must have assured access to those components of government or decision-making it is seeking to advise at the appropriate level. Access is a necessary condition for the advisory mechanism to be effective and for it to produce timely and relevant advice. This involves an iterative process of knowledge brokerage which begins with the collaborative work of framing the policy question and continues through ongoing dialogue between policy and science community collaborators to ensure that the evidence provided aligns with the needs of the policy community. For this work, knowledge brokers require scientific understanding, political acumen and an understanding of policy dynamics and contextual particularities.
4. **Diversity**: Those undertaking evidence synthesis and brokerage must be attuned to potential biases in their own assumptions and processes, because expert judgment plays a critical part. Science advice mechanisms comprising a diversity of expertise, cultures, and languages (where relevant to context) help to uncover hidden bias, which supports self-reflexivity in individuals and teams. This principle acknowledges that science is not free of values and that there is an inferential gap between what is known and what is concluded. These issues can be particularly apparent in the context of cultural, linguistic, and socio-economic diversity
5. **Reducing uncertainty**: This principle holds that the main function of knowledge brokerage is to clarify what is known, not known, knowable and unknowable about an issue without seeking to provide a definitive answer or explanation, but rather to reduce doubt to the extent possible, from multiple perspectives.

These principles, together with the functions that the science advisory mechanism is expected to perform, have strong design implications.

PAST AND CURRENT MODELS OF SCIENCE ADVICE

The following description of science advisory models concentrates on the general structures that have been used to support decision-makers through knowledge synthesis and brokerage on an ongoing basis. These models variably help to frame questions, identify relevant experts, oversee knowledge synthesis reports, and generally coordinate across the science-policy interface. The typology below discusses the main types of structures developed so far, followed by a discussion of the types of functions they undertake.

In listing these types, however, it is important to note that no single component acts in isolation. As interfaces between science and policy, these structures exist in an ecosystem which is shaped by history, and by cultural, institutional, and political-economic contexts. The discussion below focuses on advice to the executive function of government. It acknowledges – but does not focus on – engagement with the public or with the legislative function, which are also essential in a complete ecosystem. The discussion concludes with a look at the typical contexts in which science advice is operationalized.

Structures

1. **Individual Chief Science Advisor**: The model of the individual chief science advisor (CSA) has been developed in countries such as Canada, New Zealand, Malaysia and the UK. Additionally, the Province of Québec and a number of Australian States provide examples of a sub-national level CSA, which is constituted fully independently of the national (federal) level. Typically, the CSA is either a position seconded from academia, but retaining a small academic appointment or a senior appointment, following a career as a practicing academic.

Some jurisdictions prefer a more distributed model to deal with a perceived disproportionate influence of an individual advisor. This issue was at the heart of the disbanding of the Office of the Chief Science Advisor to the European Commission, a pioneering role that lasted for a single presidential tenure. In an increasing number of jurisdictions (e.g., New Zealand, UK, Estonia) the CSA reporting to the chief executive of government is supported by a committee of science advisors or chief scientists in individual ministries thus creating a de facto advisory board.

2. **Science Advisory Office / Agency**: This model is often part of the administrative apparatus rather than attached to the government of the day. However, the director position may be a government appointee, sometimes by multi-party consensus or vetting. Science advisory offices and agencies are therefore often seen as closer to the inner workings of government and, in the case of regulatory agencies, essential to the functioning of the government. The US Office of Science and Technology Policy follows such a model.

3. **Science Advisory Board**: This model typically comprises a mix of recognized experts in a variety of fields. In general, these are independent experts who are external to the organization and can provide strategic advice on its activities and direction. Chairs and members typically serve a term of 2-3 years, with incoming members often recruited according to the evolving long-term knowledge needs (e.g., digital transitions, demographic change, biodiversity, etc.).

When the European Commission disbanded the Office of the Chief Scientist to the President,the function was replaced with a more diffuse model of seven appointed CSAs within a Science Advisory Mechanism (SAM). The 7 member CSA group is supported by a dedicated secretariat. To ensure connectivity to the science community, funding is provided to support the Science Advice for Policy function of the European Academies, SAPEA as well as outreach to the growing European Science Advisors' Forum (ESAF) of national CSAs, where these exist.

4. **Science Advisory Council**: This model is much like a Board, however in addition to experts a Council will often include external stakeholders and partners (e.g., citizens, beneficiaries, and civil

society groups), as well as executive members of the organization receiving advice. It may even be chaired by the senior executive, as is the case with the Japan's Council for Science, Technology, and Innovation, which is chaired by the Prime Minister and includes cabinet ministers alongside a small full-time staff and heads of academic/expert organizations and the private sector.

5. **Academies**: In several countries, national academies figure significantly in the science advisory ecosystem, with some serving as the primary source of science advice for governments. However, a purely academic model of science advice can suffer from a lack of brokering mechanisms which help frame questions that both protect scientific integrity while meeting the needs and timeframe of policy-makers. As such, this model is generally not effective for many policy relevant matters and their work generally supports evidence synthesis rather than brokerage, which thus limits their impact.

One solution to this problem is to establish an intermediary organization that can act as knowledge broker and coordinator of the evidence synthesis process. Such an organization can bring together academicians who jointly select the government-requested studies to be undertaken each year. A formal model is then applied to identify experts, co-develop the study questions, and coordinate the review of evidence to present to government. The Council of Canadian Academies (CCA) has performed this function for the Canadian government since 2005, and Australia has a similar model with a parent group, the Australian Council of Learned Academies (ACOLA), which links five academies. However, this model does not work for questions that require rapid responses, such as in an acute crisis. Nor does it usually allow for the informal interactions that occur in the early stages of policy development when officials are processing a range of ideas.

FUNCTIONS OF SCIENCE ADVICE AND REQUIREMENTS FOR SUCCESS

While all the models listed above can deliver science advice to help inform government decisions, each will have functional strengths and weaknesses, such as whether they can be nimble enough and have the access to provide effective and timely advice during a crisis. Long term effectiveness of any model generally depends on three factors:

- A credible link to the necessary range of scientific expertise for the particular situation: generally, this means integrating social sciences, health sciences, natural and physical sciences.
- Restricting advice to evidence provision and the options that follow, without advocating a particular policy response. While advisors must remain attuned to the values and policy implications of the evidence they provide, judgement on such matters is a matter for the policy community. Good brokerage practice ensures this interface is well managed.
- A high level of access and trust between the advisory mechanism and the policy community.

Typically, there are four types of functions that could be performed by science advice to governments:

1. **Respond** to government requests on topics of policy or public interest;
2. Provide foresight including on technology assessment, horizon-scanning and **pro-actively raise awareness of issues**;
3. Mobilize and manage relevant knowledge and prepare **advice during crises**;
4. Serve in a **science diplomacy** capacity, providing knowledge as basis for negotiating collective action responses to issues.

Different parts of the ecosystem must understand whether they are acting as brokers and/or synthesizers and must be clear about which function they are intended to fulfil. This has

implications for their methods, timeframes, degree of independence, ability to solicit a diversity of voices etc. The brief as to the purpose of the advice should be clarified at the outset: is it to explain a system, clarify options and implications, or review a technology, for instance? Is it retrospective, in real time or prospective? Each of these different purposes requires different kinds of methods for which some models are naturally better structured than others.

Contexts

Just as the functions of science advice have implications for the structure of the model, so too do the contexts in which science advice is undertaken and applied. Of particular significance is the distinction between rapid advice for crisis and long-term foresight and advice for emerging issues. The methods and structures for each are not necessarily interchangeable. Similarly, a distinction should be made between the context of formal science advice (studies, reports, etc.) and informal science advice (conversations, comments, feedback etc.). The latter is often the most influential in the actual policy process. There is a role for both types but they both must be accommodated structurally to be successful. For instance, informal advice often cannot occur without co-location or regular meetings of the advisory mechanism and the executive. For these reasons, some consideration of both function and context is important in designing a model of science advice.

While many national models for science advisory mechanisms can point to lessons and opportunities, they presuppose a policy and/or decision-making authority by the advice recipient. Thus, the transposability of these models to a new context must be carefully considered. In any case, clarity on who requests and receives the scientific advice is important to support the key principles highlighted above.

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