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Science advice at the top: a global overview of chief science advisor model in governance

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Science advice plays a key role in policymaking, with governments adopting various models to integrate expertise into decision-making. This study provides a preliminary overview of the Chief Science Advisor (CSA) model, examining its adoption across different governance structures. Our mapping analysis identifies seven countries—the US, the UK, Canada, Australia, New Zealand, India, and Ireland—that have formally institutionalized this model, while also exploring cases where it has been discontinued or never fully formalized. While the CSA is not the sole mechanism for science advice, it offers a distinct approach that balances expert guidance with political realities. Through qualitative analysis of expert interviews with former CSAs, public officers, and policy experts, we examine the professional backgrounds, competencies, and strategic roles of CSAs as well as their agenda. By assessing both the strengths and limitations of this advisory structure, this study contributes to discussions on enhancing evidence-informed governance and public trust in decision-making.

Keywords: science advice; evidence-based policymaking; science communication..

1. Introduction

Governmental decisions are shaped by a combination of social, political, and economic considerations. Scientific knowledge and evidence-based insights can significantly contribute to these processes, informing decision-making and policy formulation. However, integrating science into governance presents several challenges, including the complexity of research, limited accessibility of data, and the difficulties of embedding evidence within political systems. To address these challenges and enhance the quality of decision-making, governments establish science advisory bodies tasked with providing expert guidance and facilitating the use of scientific evidence in policy development (Doubleday and Wilsdon 2012).

While scientists have advised governments throughout history, an often *ad hoc*, on-demand approach has been increasingly formalized over recent decades through the establishment of permanent offices within governments. Gluckman (2014 p. 165) observes that advisory models vary according to country's history and social structures. Many authors before us (Grobbelaar 2008; Hutchings and Stenseth 2016; Melchor 2020) have mapped the plethora of governmental advisory models. Hutchings and Stenseth (2016) came up with seven advisory models: advocates, advisory committees, government scientists, supranational organizations, legislatively responsible advisory bodies, National Academies and Offices of Chief Science Advisors. Wilsdon (2014) focuses on three models only: advisory councils, national academies and chief science advisors.

Four of these systems stand out as most commonly used across systems, often in combination, meaning they are not mutually exclusive: Advisory councils, Advisory committees, National academies, and Chief Science Advisors (Melchor 2020 p. 294; OECD 2015).

1.1 Model of a chief science advisor

This study focuses exclusively on the model of the Chief Science Advisor (CSA). Drawing on definitions found in the existing literature, we define a CSA as an individual—typically but not necessarily a senior scientist—who provides direct advice to the head of government (the Prime Minister in parliamentary systems or the President in presidential systems) on matters related to science and technology. While the term is sometimes used to label positions at the sub-national level and in supranational organizations, or in the private sector, this study focuses on CSAs who advise the head of government directly.

Our reason for focusing on the CSA model is to build a better understanding of the position, including skills, competencies, attributions, and background. We do not mean to prescribe this model over the other models, but rather to draw a preliminary landscape of how the CSA operates, and how they can interact with other existing models. The CSA role is particularly worthy of closer examination due to its proximity to political leadership and the individualized nature of the position. Unlike group-based advisory bodies that mostly operate through consensus (McComas et al. 2005; Groux et al. 2018), the CSA offers a direct and often informal line of communication to the head of government. This unique access raises important questions about who performs this role, how it is structured, and what skills and responsibilities it entails—areas where existing research remains limited.

Doubleday and Wilsdon (2012 p. 302) emphasize that scientific expertise alone does not determine how effectively

a CSA integrates into the broader policymaking system. They reference a report by the UK House of Lords Science and Technology Committee, which outlines key qualities required for a CSA beyond scientific credentials: *'an ability to engage with stakeholders; to manage multidisciplinary teams; to understand the policy environment; and to be able to evaluate conflicting evidence from a range of perspectives'*. These qualities extend beyond the traditional skill set of a scientist and often need to be developed through other means. However, our preliminary literature review revealed a gap in understanding the professional backgrounds of current CSAs, somewhat limiting our ability to conceptualize a comprehensive CSA profile for further research.

Similarly, the duties of a CSA remain underexplored in the existing literature. The OECD (2015 p. 41) emphasizes the importance of clearly defining roles and responsibilities in its checklist for science advice, including the delineation between advisory and decision-making functions, potential liability, institutional support, and expertise in communication. The UK Guidance for CSAs and their officials states that *'The Government Chief Scientific Adviser (GCSA) is responsible for putting excellent science advice at the heart of decision-making through the provision to the PM and Cabinet of proactive and demand-led science advice that is relevant, excellent, and delivered fit for purpose and working across government to implement science advice mechanisms that are efficient, effective, speak truth to power and are embedded irreversibly in government systems'* (Government Office for Science 2025).

Beyond the officially stated responsibilities, CSAs often engage in informal activities that significantly contribute to the effectiveness and sustainability of this advisory model. Gluckman et al. (2021) suggests that there are two main processes that are essential for any model of scientific advice to governments: evidence synthesis and knowledge brokerage. Indeed, the book *The honest broker* (Pielke 2007), popularized the use of the term. A broker is an intermediary, who serves as an interpreter in a negotiation process, where the parts do not necessarily understand each other (Wilsdon 2014). In this sense, the CSA or any science advisor should be able to synthesize evidence and translate it into useful information for the policy-maker. Evidence synthesis can be provided by the CSA, or by institutions like national academies of science (Saner 2016). For a process to work, we need both the synthesis and the skill of the broker. Trust, transparency and legitimacy are also pointed out as essential components of a successful advisory model (Gluckman et al. 2021).

Grobbelaar (2008) categorizes recipients of such advice into four groups: advice to the highest level, ministerial arrangements, advice to the Legislature, and other structures. Within this framework, the CSA model serves the purpose of advising the highest governmental level—namely, the Prime Minister or the President. CSAs can either be appointed by the Prime Minister or President or serve as career civil servants.

Unlike sector-specific advisors, the CSA is not limited to a few selected topics but addresses all areas of policy and decision-making that can benefit from scientific evidence—a meta-level approach. While CSAs may focus on specific issues during times of need, their scope remains broader than that of topic-focused advisors, whose roles often align with ministerial divisions. For instance, in the UK, sectoral advisors operate within an intricate and sophisticated system. Røttingen and Ottersen (2018) highlight examples of such advisory roles, noting that having a coordinated system of the use of science across different sectors such as public health, food safety, environment and energy can be beneficial.

From a broader perspective, existing research on the topic (*e.g.* Glynn et al. 2003; Grobbelaar 2008; Wilsdon et al. 2014) examines various types of advisory bodies and provides case studies for individual countries. However, there is a notable lack of a contemporary overview of the CSA model's complexities. This includes identifying where this particular model is employed, compiling a background summary of the individuals serving as CSAs, and analysing how the role is integrated into governance systems.

Addressing critical research gaps and limitations in past scholarship, this study offers a preliminary analysis of the CSA advisory model. The primary research aim is to map the CSA landscape: where the model is employed, how it is integrated into broader governmental structures, and the local contextual specifics of the position. By examining job descriptions, we derive a skill set and supplement it with a professional profile of current CSAs. We also examine how evidence synthesis and brokerage fit into the CSA model, and weigh pros and cons of this model in comparison to councils and committees, without losing perspective of the interaction among models.

1.2 Historical origins of the CSA

The role of the CSA emerged during the mid-20th century, shaped by the scientific mobilization triggered by World War II. Both the US and the UK were instrumental in institutionalizing high-level scientific advice to the government, driven by the urgent need for technological innovation and military superiority. Since then, the CSA role has expanded to address a wide range of public policy challenges, including climate change, public health, and digital governance.

In the US, the roots of federal scientific advising trace back to the establishment of the Office of Scientific Research and Development (OSRD) in 1941, led by Vannevar Bush. Under Bush's leadership, the OSRD coordinated unprecedented research efforts that led to transformative technologies such as radar and the atomic bomb. Bush's influential 1945 report, *Science, The Endless Frontier*, called for continued federal investment in basic research through the creation of an independent funding agency—a vision realized with the establishment of the National Science Foundation (NSF) in 1950.

The Office of Science and Technology Policy (OSTP), created later, in 1976, developed out of the *ad hoc* presidential science advisory apparatus that evolved during and after WWII, particularly through bodies like the Scientific Advisory Committee (SAC) under Truman and the President's Science Advisory Committee under Eisenhower and Kennedy (Blanpied 2010; Evans and Matthews 2024a).

In the U.S. system, the Director of the White House Office of Science and Technology Policy (OSTP) frequently, though not always, also holds the additional title of Assistant to the President for Science and Technology (APST). This designation formally identifies the individual as the President's Science Advisor. The overlap between OSTP Director and APST has created a strong institutional linkage between OSTP and the CSA function, though administrations have varied in how explicitly they connect the two roles. Whereas the OSTP Director is a presidential appointment requiring Senate confirmation under the National Science and Technology Policy, Organization, and Priorities Act of 1976 (U.S. Code 1976, 42 U.S.C. § 6 612), the APST designation is conferred directly

by the President without Senate involvement, reflecting its status as a White House staff role rather than a statutory office (Lane and Matthews 2009; Blanpied 2010; The White House 2022).

This lineage reveals a more complex institutional genealogy, in which advisory structures initially formed within the executive to support defence needs gradually evolved into permanent bodies advising on a broader array of scientific and technological matters.

The modern structure of OSTP and the re-establishment of a presidential science advisory council (PCAST) reflect this legacy. Since its inception in 1990, PCAST has functioned as both a technical advisory body and a political instrument, symbolizing the administration's commitment to science and technology. As shown by Evans and Matthews (2024a, 2024b), PCAST has alternated between instrumental and symbolic roles, depending on the administration's priorities, the autonomy of its members, and the visibility of its recommendations.

Yet, this dual role also underscores a persistent tension in science advising: the advisor must support presidential decisions while maintaining scientific objectivity and public trust. This is especially apparent when advisors engage in budgetary matters or public outreach, where advocacy can be perceived as politicization. Lane and Matthews (2009) highlight this dilemma, noting that science advisors risk losing their influence if seen as representatives of the scientific community rather than as trusted, neutral counsellors to the President.

In the UK, CSA also crystallized during World War II. Figures such as Sir Henry Tizard and Lord Cherwell (Frederick Lindemann) advised the British government on critical technologies, including radar. Tizard's wartime mission to the US facilitated the transfer of scientific knowledge that would prove vital to Allied success. The formal role of GCSA was established in 1964, offering direct advice to the Prime Minister and gradually expanding in scope to support multiple departments across Whitehall (Jones 1978; Edgerton 2006).

Canada formalized its CSA position only in 2017, but the country has a longer advisory tradition dating back to the wartime efforts of individuals such as C.J. Mackenzie. The current CSA of Canada plays a central role in advising on policy, fostering open science, and engaging the public (Government of Canada 2018).

In Japan, the establishment of the Science and Technology Agency (STA) in 1956 provided a centralized mechanism for science-policy coordination, while Germany's Wissenschaftsrat, founded in 1957, remains a cornerstone of federal science advisory. Both countries adopted hybrid models in the post-war period, reflecting broader shifts towards institutionalized science governance (Nakayama 1991).

Across these contexts, the rise of the CSA role reflects a broader global consensus on the strategic necessity of scientific advice in policymaking. While institutional forms vary, they all attempt to reconcile expert neutrality with political relevance—an enduring tension at the heart of science-government relations.

2. Methodology

This study employs a mixed-method qualitative approach, combining a global mapping analysis with semi-structured expert interviews to investigate the institutional role and required competencies of CSAs in government.

Table 1. Overview of the study participants.

Category of the participant	Count
Former CSA	3
Public officer	6
Policy expert (think-tank/NGO)	3
Policy expert (scholar)	3
TOTAL	15

2.1 Mapping analysis

First, we conducted a mapping analysis to describe the global CSA landscape. This included identifying the countries that have implemented the CSA model, the year each office was established, the official title of the position and the office, individuals currently holding the role, and the selection process, appointment type and contract period. Data were systematically collected from publicly available sources, including official government and CSA office websites, published job descriptions, government science advisory frameworks, policy documents, and where relevant, reputable media articles. This mapping formed the foundation for understanding how the CSA position is structured and institutionalized across different national contexts.

2.2 Interview sampling and data collection

We conducted semi-structured interviews with 15 participants across nine countries between February and May 2024. Interviews were done virtually and lasted approximately 60 minutes each.

To build the sample, we initially contacted all identifiable CSA offices (excluding Ireland which was reinstated after the data collection period) and formally invited their representatives or current CSAs to participate in the study. While several offices acknowledged the request, only two CSA offices provided input *via* written correspondence; others declined or did not respond. To address this, we employed a snowball sampling strategy, supplemented by the authors' existing professional networks, to identify additional relevant participants. This enabled us to interview a sufficient range of former CSAs, public officers, and policy experts with insight into science advisory (Table 1).

While some CSA countries are underrepresented in the quoted material, the sample provides robust coverage of long-established CSA systems—such as those in the UK, the US, and New Zealand—whose perspectives are particularly valuable due to their extensive institutional experience with the role.

Semi-structured interviews were carried out with two tailored guides (see Appendix A): one for the (former) CSAs and one for public officers and policy experts. Both guides focused on the core themes such as the national science-advisory environment, perceptions of the CSA role, agenda, expertise, and skill-set. For CSA interviewees, an additional module explored personal experience and informal aspects of the role. Throughout, participants were invited to raise issues they considered important, ensuring the discussion also captured context-specific insights.

2.3 Data handling and analysis

All interviews were conducted virtually, recorded with consent, transcribed verbatim, combined into a dataset, and de-identified to protect participants' identities due to the sensitivity of the topic and the seniority of roles involved. When

quoting participants, we use general role descriptors ('former CSA,' 'public officer', or 'policy expert') to preserve contextual richness while protecting identity.

A thematic analysis was performed by applying codes deductively based on our research questions—professional background, key skills, and formal agenda—and identifying additional themes that emerged from the data inductively, capturing unexpected nuances related to network dynamics, communication strategies and other more informal practices. The codes were categorized into a thematic framework, capturing both the expected dimensions of the CSA role and the unanticipated practices that underpin its effectiveness in practice.

3. Results

3.1 Current CSA landscape

As of June 2025, seven countries worldwide have officially appointed CSAs: the US, the UK, Australia, India, New Zealand, Canada, and Ireland. Table 2 provides the official title of the position, the associated office or agency, the year the role was established, and the names of current CSAs. To be included in this list, a CSA must hold an official active position within their government. Research constraints influenced these decisions, as our analysis relies on official sources such as governmental websites where CSA roles and responsibilities are documented.

All countries with currently appointed CSAs are member states of the OECD (with India as a key partner) and have English as one of their official languages. Some countries adopt unofficial advisory structures resembling the CSA model. For instance, a council of advisors may include one individual with a closer connection to the Prime Minister or President. Singapore exemplifies this approach, as noted by a study participant. Additionally, expert interviews highlighted cases where individuals fulfil CSA-like roles without an official mandate, including examples from Jamaica, Rwanda, and Senegal.

Some countries have discontinued or are in the process of establishing CSA roles. Malaysia maintained a CSA Office from 1984 until 2018, when it was discontinued under a new administration. The Czech Republic briefly maintained a CSA position from 2011 to 2014. The CSA role primarily focused on managing the national scientific ecosystem rather than providing direct scientific advice (Rychlík 2012).

In Ireland, the CSA position existed from 2004 to 2022 and was reinstated recently (Government of Ireland 2024). The reform aimed to separate the CSA role from the Director General of Science Foundation Ireland to ensure greater independence and establish a broader science advisory framework led by the National Science Advice Forum (O'Brien and O'Halloran 2021; Department of Further and Higher Education, Research, Innovation and Science 2023).

Japan's case illustrates the emergence of a CSA model in progress. Although not yet fully institutionalized, the role is set to be integrated with the head of the Japan Science and Technology Agency, signalling Japan's commitment to establishing a formalized advisory system (Montgomery 2023).

3.2 Profile of a CSA

In this section, we outline the profiles of current CSAs and highlight key skills and attributes. This overview provides insights into the professional backgrounds of individuals appointed to this position, as well as the experiences, competencies, and personal traits. These characteristics should not be viewed as prescriptive requirements for the role but rather an exploration of the qualities valued by the CSAs themselves, their colleagues, and experts in the field. This analysis can serve as a reference for governments seeking to establish advisory systems and considering criteria for recruitment. See the summarized results in Table 3.

3.3 Scientific background

We examined current CSAs professional backgrounds, scientific training and work experience. This analysis was based on publicly available curricula vitae and personal profiles from official websites.

The vast majority of current CSAs are trained in fields historically associated with the role—namely biology, physics, chemistry, and medicine. Specifically, their expertise spans subfields such as mathematical biology (the UK's CSA), oceanography (Australia's CSA), quantum physics (India's CSA), molecular cardiology (Canada's CSA), and evolutionary genetics (Ireland's CSA). Two recently appointed CSAs diverge somewhat from this disciplinary pattern and merit closer examination. New Zealand's current CSA has a background in agricultural science—a less common field among CSAs—though he holds a Ph.D. and maintains strong academic credentials.

In contrast, the current CSA in the US stands out as a clear outlier. He holds a BA in political science and does not have a doctoral degree. His professional experience is rooted in the private sector, mainly in the field of artificial intelligence, complemented by senior policy appointments in the federal government. Most notably, he served as the US Chief Technology Officer—a leadership role within the White House Office of Science and Technology Policy—and later as Acting Under Secretary of Defence for Research and Engineering at the Department of Defence (Erwin 2020), a position that placed him at the center of military R&D and high-level defence policy. While his background may offer valuable insights into emerging technologies, it reflects a shift away from the more traditional scientific research credentials typically associated with the role. (Garisto and Tollefson 2025) This evolving profile presents an important case for future research, particularly in understanding how non-traditional backgrounds may influence the function, credibility, and perception of the CSA position.

One participant in our study, a former CSA, noted that science advisors often come from medical fields, which equips them with a unique combination of expertise in natural sciences and an ability to consider the human aspects of scientific interventions. However, reflecting on the historical roots of the CSA model, it becomes evident that early advisors, particularly in the UK and the US, were closely connected to engineering disciplines, specifically defence technology. This trend was largely shaped by the historical context of World War II. Even in more recent years, this connection persists in some countries, such as India. The country's first two CSAs, Abdul Kalam (1999–2001) and Rajagopala Chidambaram (2001–2018), were trained in aeronautical engineering and nuclear physics, respectively. Abdul Kalam, who later became India's president, earned the title 'Missile Man' for his contributions to the Defence Research and Development Organization,

Table 2. Current CSA landscape (as of June 2025).

Country	Official title	Office	Established	CSAs count	Current CSA	Selection process	Appointment type	Contract period
United States	Chief Advisor for Science and Technology	Office of Science and Technology Policy (OSTP)	1941	23 (35 incl. Acting CSAs)	Michael Kratsios	Appointed by the President, confirmed by the Senate (Presidential Appointment with Senate confirmation, PAS).	Political appointee, serves at the President's discretion.	No fixed term; serves at the President's discretion, typically resigns with administration changes.
United Kingdom	Government Chief Scientific Adviser (GCSA)	Government Office for Science	1964	14	Angela McLean	Appointed by the Prime Minister through an open competition process.	Civil servant under government employment.	Typically a 5-year contract.
Australia	Chief Scientist (ACS)	Office of The Chief Scientist	1989	10	Tony Haymet	Appointed by the Prime Minister based on a recruitment process run by the Minister for Science with open advertisement.	Independent appointee following public service codes.	3-year term, renewable.
India	Principal Scientific Adviser (PSA)	Office of the Principal Scientific Adviser	1999	4	Ajay Kumar Sood	N/A	N/A	N/A
New Zealand	Prime Minister's Chief Science Advisor (PMCSA)	Office of the Prime Minister's Chief Science Advisor	2009	3	John Roche	Appointed by the Prime Minister based on a recruitment process with open advertisement.	Independent appointee, often seconded from academia.	3-year term, renewable without limit.
Canada	Chief Science Advisor	Office of the Chief Science Advisor	2017	1	Mona Nemer	Appointed by the Governor General on the Prime Minister's recommendation following an open advertisement.	Independent civil servant, appointed through competition.	3-year term, renewable; current CSA reappointed twice for 2-year terms.
Ireland	Government Science Advisor	National Science Advice Forum	2024	1	Aoife McLysaght	Appointed by the Minister for Further and Higher Education, Research, Innovation and Science following the recommendation by the Top Level Appointments Committee (TLAC).	Civil servant under government employment.	N/A

Table 3. Summary of the current CSA professional profile.

Dimension	Observed patterns	Primary source(s)
Academic discipline	Biology, physics, chemistry, and medicine remain dominant fields; recent appointments show growing diversity (*e.g.* agricultural science, AI).	Bios (CSA/government websites; public CVs)
Typical qualifications	Most hold PhDs; often with leadership roles in academia or scientific institutions.	Bios; interview data
Prior experience	Experience spans public research bodies, university leadership, advisory councils, and occasionally industry.	Bios; interview data
Key soft skills	Communication, diplomacy, discretion, political awareness, and trust-building emerged as core interpersonal competencies.	Interview data

including the development of India's first intermediate-range ballistic missile in 1989 (Encyclopaedia Britannica 2024).

Some participants remarked on the prevalence of science advisors with backgrounds in engineering and defence technology, suggesting that during periods of heightened risk—such as potential attacks or other crises—science advice tends to gain greater prominence, with policy-makers and politicians being more receptive to it. This pattern was evident during the COVID-19 pandemic, which sparked significant debates about the integration of scientific evidence into policy-making (*e.g.* Bastani et al. 2022; Hammersley 2023; Matsuda and Yoshimura 2023). Given today's global challenges—such as health crises, food security, climate change, and ongoing conflicts in various regions—researchers should closely examine how these circumstances may shape the future of science advisory roles.

3.4 Trusted academic credentials

Academic credentials are seen as critical for establishing trust within the scientific community. Reflecting on the strengths of the current UK's CSA, a public officer noted how respected she is within the academic community, possibly because of strong academic background helping her to get the trust of scientists both across the government and outside. This sentiment was echoed by a former CSA, who stated: "*You have to have your academic credentials and your science credentials so that politicians can trust that you've got something sensible to say. If you brought in somebody who had been a scientific manager in the industry but was not seen as credible to the academic base, that would be problematic.*"

In the US, academic credentials were acknowledged as important but viewed alongside other types of experience. A public officer described the qualifications of the former US CSA, Arati Prabhakar, as follows: "*She's got a deep understanding of two big federal agencies and she also has experience in Silicon Valley with venture capital. So she understands the industrial perspective and the government perspective. I think that people who come in with those different experiences have a better way of understanding what the needs are, and a sensitivity to the concerns of different communities*". Trusted academic credentials might also facilitate a good interaction between the CSA and the national academies. As stated by a former CSA: "*The National Academy is critical because they do so much of the evidence synthesis. And I would ask them, when it was a slow burn issue, to do the evidence synthesis rather than me doing the evidence synthesis, or we would do it together and write reports. And so it comes back to how you work with the science community, so [that] they trust that you'll reach out to them when their technical advice is needed.*"

3.5 Managerial and industry experience

In addition to their academic careers, all current CSAs have demonstrated leadership through various high-level managerial positions in committees, research organizations, and governmental bodies. Some CSAs have also gained valuable experience in industry.

A former CSA reflected on the value of industry experience, stating: '*I think it was helpful that I had a background in both industry and academia. Ministers quite wanted to know about things in the industry and where science was going. And it gave a level of credibility, which I think was important.*' The participant further noted that managing large organizations with hundreds of people helped to frame his advice in a way that was '*useful for people who have to get things done, which is not always obvious if you have spent your life entirely in academia, where you might just have your own group to worry about.*' This dual experience enhanced the ability to communicate effectively with diverse groups and address their specific needs.

A public officer concurs: '*I think people who come in with those different experiences have a better way of understanding what the needs are, and a sensitivity to the concerns of different communities.*' Managerial and industrial experience, therefore, emerge as significant assets for CSAs.

3.6 Professional capabilities

We analysed the professional capabilities of current CSAs, focusing on soft skills and personal traits. Self-evaluations by former CSAs and observations from public officers and policy experts interviewed in this study identified a range of characteristics that contribute to a more nuanced CSA profile.

3.7 Communication skills

Communication skills were frequently mentioned, particularly in relation to the industry experience discussed earlier. These skills primarily involve interpersonal communication—effectively conveying messages to diverse audiences and actively listening to a broad range of stakeholders, including those outside the policymaking arena. One public officer noted: '*I think that it's very important for the science advisor to be able to speak to the scientific community outside of government, whether that is an industry or academia or non-governmental organizations. To be able to listen to them and bring their concerns and their perspectives into the decision-making.*'

In terms of communication style, the UK's CSA was commended by a public officer for her clarity and directness. Similarly, the former CSA in the US, Arati Prabhakar, was highly regarded for her language skills and approachable demeanour as expressed by another public officer: '*She's very*

good with words, she can speak very fluently and effectively. She's also warm in dealing with people—she projects an interest in people she meets and seeks to make connections, even if it's just a phrase or a sentence, to bring people into what she's talking about.'

The importance of communication skills is in accordance with the literature, where several authors highlight the importance of brokerage and translation of scientific knowledge (Haynes et al. 2012; Wilsdon 2014; Hutchings and Stenseth 2016; Gluckman et al. 2021).

3.8 Other capabilities

In addition to scientific credentials, managerial or industry experience, and communication skills, several other capabilities were identified in our interviews as relevant to the CSA position. These include openness to new ideas and diverse perspectives, the ability to build professional connections across multiple areas and organizational levels, a deep understanding of government processes, leadership skills, and the capacity to prioritize effectively.

A former CSA emphasized that the role requires a strong spirit, particularly in the following ability: *'I think the difficulty is if the person does not have the capacities to really give truth to the power. We have seen some science advisors become tools of the political process.'* This quality is closely tied to the ability to remain impartial and cross-partisan, which demands both mental resilience and humility, as the former CSA further noted: *'If you are a good science advisor, you have to accept that while you may give advice and you want it to be listened to, you cannot get angry if the advice is overridden because of political considerations. That is just the reality. What goes wrong is if the trust between the science advisor and the politician is lost because the science advisor does not like the decisions that are made and goes public and loses the trust of the Prime Minister.'* The respondent consequently highlighted the importance of self-awareness, a quality repeatedly mentioned by other participants as well: *'You need to be honest about what you know and do not know yourself. Hubris is a big enemy of science advice.'*

3.9 Use of skills in the process of advising

When discussing the toolkit required for the role, a former CSA outlined his approach through four framing questions that a CSA should consider before providing advice. These questions offer a good starting point for establishing an effective advisory process and underscore the implicit skills necessary to excel in this role. For clarity and relevance to this study, we have slightly rephrased them.

1. **Evidence synthesis**: Is the evidence base adequate? If not, what can be done to improve it?
2. **Explanation**: Has the evidence been clearly understood by the politician or decision-maker, including its uncertainties?
3. **Policy relevance**: Can the science advice be articulated in a way that is relevant to policy?
4. **Monitoring**: Can science and technology approaches be used to monitor whether the effects of a policy or decision align with its intended outcomes? Specifically, can you help decision-makers understand how to monitor these effects?

Mastering the skills required to address these questions and take appropriate action forms a roadmap to delivering high-quality science advice. The second and third questions underscore the importance of effective communication when working with policy-makers. In explaining the evidence, it was emphasized that a CSA must ensure that the recipient of the advice—often without scientific training—fully understands the broader context, including any uncertainties. Policy-makers often seek definitive answers, so it is crucial to articulate *'what the uncertainties are, what might change, why it might change, and how we might know,'* as one former CSA noted. Additionally, framing the advice in a policy-relevant manner ensures that the evidence is understood within a real-world context, increasing the likelihood that it will be taken into account rather than disregarded.

Beyond understanding the policymaking framework, familiarity with the organization and dynamics of the scientific world is equally critical—something that does not automatically come from being a scientist. A policy expert emphasized this capability, stating: *'A good scientific advisor should know how science is organized, that is, how is it delivered, who is doing what, where can the money flow be identified, where is the labor force. There is no such thing as objective advice, but there is going beyond individual interest or a specific group interest, and trying to maximize the public good.'*

3.10 Agenda of a CSA

In the following section, we describe the role of CSAs in terms of their professional duties. By outlining the core agenda of CSAs as seen in Table 4, we identify common features of this advisory model across different countries while also highlighting variations that demonstrate how the model adapts to local contexts and governmental needs.

Besides the data collection and interviews, a valuable resource identified during our mapping was the UK Government's Guidance for Government Chief Scientific Advisers and their Officials, which offers a comprehensive, operational overview of CSA functions and their integration within broader advisory mechanisms (Government Office for Science 2025).

3.11 Advisory to the government

In essence, the CSA's primary purpose is to provide science-related advice to the Prime Minister or President, depending on the governance structure. This is the key priority and must adhere to the highest standards, while maintaining independence. The whole process of advising the government on matters related to science, however, is not straightforward and CSAs must navigate a number of tensions (Table 5).

The advisory process is frequently described as a combination of *evidence synthesis* and *knowledge brokerage*. A CSA's primary responsibility is to gather available scientific evidence, seek additional input from the scientific community if required, and present it to the Prime Minister or President in a clear and concise manner. The ultimate decision-making lies with the government, as the CSA's role is limited to delivering advice and ensuring it is fully understood, including its uncertainties, risks, and implications. While this description simplifies the inherently complex, iterative, and often *ad hoc* nature of the advisory process, it encapsulates the core function of a CSA's agenda.

A critical moment in the advisory process is the delivery of scientific advice to the top. While formal documentation is

Table 4. Overview of CSA's responsibilities.

Task type	Examples of tasks	Primary source(s)
Formal (documented)	Advising the Prime Minister or President directly; attending interdepartmental meetings; evidence synthesis (internal or external); engagement with experts; identification of issues and foresighting; risk assessment.	CSA/Government websites; academic literature
Informal (practice-based)	Framing scientific advice for political timing; advising members of the cabinet; coordinating other science advisors (departments, state divisions, *etc.*); building trust; translating complex ideas into actionable insights.	Interview data

Table 5. Tensions in the CSA role.

Tension	Description	Illustrative quote
Neutrality versus Influence	CSAs must maintain an objective stance while articulating their advice as relevant to current policy challenges, ensuring it resonates with decision-makers.	'If you can't frame your advice as a policy-relevant piece of information, you will be ignored.' (Former CSA)
Brokerage versus Advocacy	CSAs must bridge rigorous scientific evidence and policy needs without endorsing particular political positions.	'I have made sure my advice is evidence-based, not opinion or advocacy. This has been well received and so my advice has been trusted.' (Former CSA)
Expertise versus Humility	CSAs are appointed for their scientific authority, but must accept that their advice may be sidelined or politically inconvenient.	'While you may give advice and you want it to be listened to, you cannot get angry if the advice is overridden because of political considerations. That's just the reality.' (Former CSA)
Accessibility versus Precision	CSAs must distill complex science into clear messages without sacrificing the technical detail and nuance to keep the advice scientifically robust.	'Good science advice is clearly communicated. Make sure you articulate things like uncertainties, caveats, and risks, especially to non-scientists.' (Public officer)
Formal Authority versus Informal Access	Official mandates grant limited formal power, but CSAs' true effectiveness lies in personal relationships, networks, and mutual trust.	'Although the job description would suggest the relationship is ready-made, the reality is that Prime Ministers are very busy people. You need to build trust and confidence that what you say is robust, helpful, and gives them a better ability to do their job. Then they'll call on you and you can insert yourself.' (Former CSA)
Confidentiality versus Transparency	CSAs must preserve the confidentiality of sensitive deliberations to foster open dialogue, while also providing sufficient transparency to uphold public trust in the advisory process.	'It's quite important that ultimately the advice should be available to the public—not the individual conversations, but the evidence base. If that's restricted, that's a problem.' (Former CSA)

typically provided to summarize the evidence, personal interaction remains a key component—and a distinct advantage—of this advisory model. As an individual advisor, the CSA has the opportunity to meet directly with the Prime Minister or President, who are more likely to share their concerns and uncertainties in a private conversation. A former CSA emphasized this point, stating: '*You need to build trust and you need to build confidence that what you are saying is robust, helpful and gives [decision-makers] a better ability to do their job—then they will call on you. But if they do not have that, then they are not going to call on you and you cannot insert yourself [in the decision-making process].*'

The notion of trust between a CSA and Prime Minister or President was emphasized by several respondents, who shared anecdotes about how politicians gradually became more comfortable admitting when they did not understand the science. In this context, the CSA often becomes a confidant to the government leader—a role that a council or group of advisors cannot fulfil with the same level of closeness. A significant part of the CSA's work therefore involves informal meetings and relationship-building as integral aspects of the advisory process. Respondents highlighted that the strength of this relationship also depends heavily on the attitudes of politicians, particularly their schedules and openness to scientific advice. Most participants expressed satisfaction with the involvement of top decision-makers, underscoring that support from high-ranking politicians is crucial to the CSA's effectiveness. Furthermore, respondents noted that public acknowledgment of the importance of scientific evidence in decision-making enhances the CSA's legitimacy and provides leverage in negotiations.

3.12 The nature of scientific advice

The nature of the advice provided by a CSA can vary in its level of technicality. As a former CSA explained, '*the bulk of the advice you are giving is strategic—how to integrate the knowledge, where are the risks, where are the gaps.*' Another critical responsibility of the CSA is to anticipate when scientific advice is needed, ensuring that the head of government is aware of opportunities to incorporate evidence into decision-making processes. This is especially crucial in emergency situations, where timely decisions are necessary. Examples mentioned by the former CSA include earthquakes, volcanic eruptions, or terrorist attacks, with the added observation that '*most crises are complex, compounding crises, and science is needed all the way in different ways.*'

In terms of the criteria that advice should meet, independence and an evidence-based foundation were stressed by the participants (Table 5). A public officer summarized this perspective, emphasizing the importance of contextual awareness: '*There is a need for that advice to be evidence-based with a strong scientific foundation, while also recognizing the*

political, economic, and social realities of the problems on which they are advising, which the elected official and their staff are keenly aware of. These often weigh just as heavily as the facts, data, and evidence. This is where some people who want to advise the government fail. We need to be aware of the environment without getting sucked into it. The best science policy advice is aware of those factors, but still guided by the evidence basis.'

A policy expert offered a nuanced critique of this emphasis on objectivity, noting that not all advice can be strictly evidence-based: *'A lot of advice is not evidence-based, because, for example, risks associated with emerging technology are highly speculative.'*

Many respondents emphasized that the CSA's primary role is focused on science for policy, not policy about science—in other words, utilizing scientific knowledge to inform decision-making rather than shaping policies that govern the research ecosystem, although some overlap between these areas can occur. In some countries, additional responsibilities are deliberately included in the CSA's official role description. For instance, in India, the role emphasizes techno-entrepreneurship, while in Australia, it includes commercialization and research performance measurement.

The concept of mixed roles is further formalized in some cases by assigning the CSA to multiple additional posts. For example, the CSA in the UK heads the Government Office for Science and co-chairs the Prime Minister's Council for Science and Technology (CST). In the US, the CSA typically serves as the Director of the White House Office of Science and Technology Policy (OSTP) and often also as the Assistant to the President for Science and Technology. In addition, the CSA has historically co-chaired the President's Council of Advisors on Science and Technology (PCAST). As of early 2025, the PCAST remains formally in existence under an active Executive Order issued in January 2025 (The White House 2025), though its membership has not yet been appointed.

Lastly, as discussed earlier, science is just one component of the decision-making process—it should inform, not prescribe. Other factors inevitably influence the final decision. A former CSA articulated this perspective: *'Science advice never makes policy. Science informs the range of options and the consequences of the choices that governments make. Remember that every government always has an option. One of the options is to do nothing. The status quo is also an option.'*

It is important to note, however, that in some systems like the UK, there is official guidance as to how to proceed, even if the Prime Minister decides not to follow the scientific evidence provided, as stated in the official guidance: *'If government is minded not to accept the advice of a Scientific Advisory Committee or Council the relevant minister should normally meet with the chair to discuss the issue before a final decision is made, particularly on matters of significant public interest'* (Government Office for Science 2010). This step ensures that the decision is not completely arbitrary, but has to be justified and explained.

3.13 Coordination of other scientific advisors

Although CSAs advise governments as individuals, their work is far from solitary. Particularly during the evidence synthesis phase, CSAs collaborate with experts from various sectors, including government administration, universities, NGOs, and other organizations. They also rely on input from other scientific advisors appointed across different parts of the government. In the UK model, for example, departmental (ministerial) advisors are responsible for specific sectors such as agriculture, health, and education. When this model is adopted, the CSA's role often includes coordinating these departmental advisors. However, the extent of the CSA's involvement in such coordination varies and may depend on factors such as the size of the network (not all departments have their own advisor), the government's demands, or the CSA's individual preferences.

A former CSA highlighted this variability, explaining: *'I inherited a system where the departmental scientific advisors were almost lone operators. They were single people in departments, and not necessarily well connected with each other.'* This CSA sought to build a cohesive network, transforming these advisors into a collaborative community. The effort proved successful: *'The CSA network turned out to be a rather effective way, such that people who wanted to get things done in the government would come to us, because we were well joined up across departments, and less siloed than many other bits of government.'* The former CSA linked this emphasis on coordination to a more robust and effective advisory system.

As highlighted by another former CSA, the coordination of departmental advisors plays a critical role in fostering a cohesive and effective advisory network. This involves supporting departmental CSAs in building and delivering scientific information capabilities. Specific tasks include organizing meetings for all advisors, forming smaller working groups to address interdisciplinary challenges (*e.g.* tackling food contamination by leveraging expertise from the departments of health, agriculture, and interior), and defining the role of departmental advisors—particularly when a new advisory position is being established. The coordinating role is particularly effective in countries with established networks (*e.g.* the UK, New Zealand) or in large and federal governments (*e.g.* India, the US).

In this study, we focused on countries with an appointed CSA, so no conclusions can be drawn about models where departmental advisors operate without a central coordinator (a bottom-up approach). However, some degree of coordination—at least in terms of processes—is critical to setting clear priorities and preventing the head of government from being overwhelmed. This was emphasized by a public officer: *'You have a national security adviser, domestic policy council, and all of these bodies providing input to the President. And then you have a single person feeding the most important and critical issues to the President. What are the things that need to make it to the President? Not everything. Actually, not 99 per cent of these things need to go to the President.'*

3.14 Other tasks to consider (or avoid)

The agenda of CSAs varies across countries depending on the governance system, the individuals involved, and local sociopolitical factors. Generally, CSAs have a certain degree of flexibility in structuring their workload and setting priorities. In our interviews, two areas of professional activity emerged as particularly challenging or divisive: public outreach and funding responsibilities.

3.15 Public outreach

The ability to communicate effectively was identified as one of the key skills for CSAs. We further examined whether these

communication capabilities should extend to public-facing activities. Most participants in our study agreed that while public engagement is not a core requirement for the role, it can occur, particularly during critical events such as the COVID-19 pandemic.

Although understanding public needs is crucial for governments—and various public engagement activities are conducted by science-focused offices—a former CSA cautioned against CSAs becoming a spokesperson for governmental decisions on science: *'Your job is not to communicate to the public the decisions that ministers have made about science—that is the job of ministers and their teams. I think there is an element of engagement in science advice, but it is to ensure that the decision-makers inside government have robust, independent, and challenging science advice.'*

Internal communication is seen as more critical. Another former CSA echoed this perspective, criticizing over-involvement in public relations activities, such as visiting laboratories or attending award ceremonies, when it detracts from the advisor's primary counselling responsibilities. The CSA also warned against public speaking evolving into advocacy for specific topics aligned with personal interests, as this could undermine the CSA's objectivity and credibility.

A public officer agrees: *'I am not sure that that position is the most appropriate one to be doing mass public communication. But certainly, there is a communications team within the White House that puts out a lot of announcements about things that the Office for Science and Technology Policy is doing and documents they are producing, so there is a fair amount of public communication.'*

However, the respondent emphasized that CSAs, as individuals, should approach public speaking with careful consideration for time management: *'Once you get that appointment, everybody wants you to speak at their event. I have seen the [former] CSA be somewhat selective in the invitations they accept. Because talking is not doing. You have to balance the need to communicate with the public with doing the work of the office.'*

The respondent concluded that, inevitably, the CSA becomes the public face of many office activities. As our data suggest, the focus should therefore remain on intergovernmental communication or targeted external publics directly involved in policymaking processes (*e.g.* industry or NGOs) or evidence synthesis (*e.g.* academia).

3.16 Funding responsibilities

The involvement of CSAs in science funding was perceived by respondents as potentially problematic or risky. A former CSA was particularly vocal on this issue, stating: *'I think the combined role is risky. And also it is just too much. If you are trying to deal with all the complexities of government and give science advice and you are trying to worry about where the funding goes, I think it is too difficult and complicated.'* The participant elaborated further, describing the challenges within the context of the funding system and financial flows: *'Even if you are being asked for advice by the science minister or the Secretariat for science about how they should think about funding allocations, you can give some science advice around that. They then need to make the choices and understand the implications of it to guide the person who's leading the funding agency. You cannot be feeding in at one end and receiving at the other end. I think it is really important not to put yourself in a position where you could be seen as a recipient of benefit because of the advice you have given.'*

There are a few exceptions to this perspective. A policy expert commenting on Japan's CSA, explained that the person on track for the job will also retain their role as the head of the funding agency. To address potential concerns, guidelines and oversight mechanisms are being developed to ensure transparency in the process. However, questions persist about whether these dual roles can ever be fully disentangled, given the CSA's inherent influence over government funding decisions for science, which are managed by these agencies. Public perception of such an arrangement is also significant, as it may impact the credibility of both the CSA and the government, regardless of operational transparency. Maintaining trust within the scientific community is equally critical and demands careful attention to mitigate any conflicts of interest.

Instances of CSAs with this dual role include Quebec, Canada or previously Ireland, where it contributed to the temporary discontinuation of the office. A former CSA shared their perspective on the Canadian example: *'I have always regarded that as a conflict. But it might just be [the case] that because he has had that role, he has built the trust of the science community in a different way.'*

4. Discussion

The need to translate evidence into policy is not new and has been addressed by several authors (Doubleday and Wilsdon 2012; Gluckman 2014; Wilsdon et al. 2014; Oliver and Boaz 2019). Neither is the need for science literacy and scientific understanding for decision-making. Nearly 20 years ago in 1995, the European Commission stressed the importance of science literacy as a critical tool for a democratic society, as highlighted by the Science Literacy report of the National Academies of Sciences, Engineering, and Medicine (2016). The OECD defines scientific literacy as the ability to *'research, evaluate and use scientific information to make decisions and actions'* (OECD 2023). The Baker Institute for Public Policy in the US published a report stressing the importance of organizing the country's advisory system right after the elections, appointing a CSA and the director of the OSTP, to make sure that scientific expertise is valued in the formulation of public policy (Matthews et al. 2016). This report complements previous reports which have been stressing the same points. The 'Flying Blind report', published by the Federation of American Scientists (Kelly et al. 2004) highlighted the need for a network of science advisors working directly with the President, Congress and the National Academies. Likewise, the report by the Carnegie Commission on Science, Technology, and Government (1992) already mentioned the importance of having the US CSA working closely with the President's office, and the OSTP 2.0 Critical Upgrade report (Bond et al. 2008) covered recommendations on how to best organize the science advisory structure in the US.

Patrick Vallance, former CSA in the UK, wrote an editorial for Science on 'Modern Governments and Science Advice', where he stresses that *'Science Advice requires dialogue, not data dumping'*, and that there is no tradition of scientists who wish to act as advisers to governments in the civil service: *'For example, in 2018, university graduates entering the "fast stream track" of the civil service in the United Kingdom were overwhelmingly made up of students from the arts and humanities; only about 10 per cent held a degree in science'*

(Vallance 2023). If we consider that the UK is a country where the CSA system has a strong decades-long tradition, and still there is a shortage of scientists in civil service, this is a warning that should not be ignored.

Vallance is not alone in raising the alarm. There have been discussions about a CSA for France (Lemaire and Massol 2024), the International Science Council has published a report on the principles and structures of science advice (Gluckman et al. 2022), the Joint Research Center for the European Commission published two comprehensive reports related to science advisory, one on the science-for-policy ecosystems in the EU (European Commission: Joint Research Centre et al. 2023) and a survey on how scientists and policy-makers view the same ecosystem, stressing the need for skill building and training programs for scientists who wish to work in advisory positions (Scharfbillig et al. 2024).

Nature has published a suite of articles on science advisory, also highlighting the need for training, both for scientists to better understand and navigate the policy world, and for policy-makers to have a better understanding of the process of science and evidence (*Nature*. 2024; Pearson 2024; Tyler 2024). The British Academy has recently published a report on 'Public trust in science-for-policymaking' (The British Academy 2024), where they investigated the use and communication of science in policy-making, taking into account levels of public trust in scientific rigour and the relevance of scientific findings.

Our work attempts to contextualize the role of CSAs as one of the many advisory models to governments. We conducted semi-structured interviews with former CSAs of different countries, as well as public officers and policy experts. We also included data available in official websites and documents. Our main goal was to draw a preliminary landscape of how this model works in different countries, cultures and backgrounds, what skills and abilities are needed for the job, and what roles and responsibilities fit the job description.

4.1 Why CSA as an advisory model?

Few countries adopt the CSA position as the main model of science advisory (Table 2). The UK serves as the best example of how this model can be organized, featuring a CSA operating with a network of advisors to every department of the cabinet. Other countries rely solely on a single CSA advising the Prime Minister or President. It is difficult to speculate what makes CSA the model of choice for these countries and not others. One common feature that might be related to social organization and cultural tradition is the fact that most countries with an official CSA are members of the commonwealth. This could mean that public perception of the traditional role of a CSA is favourable and will meet no opposition. This was one of the reasons suggested by a public officer: '*You need to consider what type of public administration you have, how you can insert those chief science advisors in your system, how you can hire them, at what level and so forth. But also how flexible is your scientific system to allow this to happen*'.

The EU has recently shifted to a committee model (Wilsdon 2014; Scientific Advice Mechanism 2025a). When the Group of Chief Scientific Advisors receives a request from the European Commission, there are a number of steps they must follow to ensure independence and transparency. First they assemble a working group, composed of unpaid experts identified by a call *via* academic networks, who then undergo a conflict of interest check. The working group meets regularly, behind closed doors, and produces a report based on the available scientific evidence. The report undergoes peer review, before it is presented to the Group of Science Advisors. The experts are not named and the advisory committee is responsible for bringing the report to the European Commission (Scientific Advice Mechanism 2025b).

The European model creates a safe distance between the experts and the decision-makers, with the science advisory group acting as intermediaries. The importance of this distance has been highlighted by Saner (2016) who argues that having a clear separation, sometimes even physical, can ensure the integrity of the advisory process, protecting the experts from political interference and fostering impartiality. Craft and Halligan (2020) also highlighted that public advisory systems rely on a series of intermediaries and their influence according to different degrees of proximity to decision makers.

Another example is the interaction between the National Research Council and the National Academies of Science in the US. The NRC usually funds and commissions the academies to produce a report on a particular topic that needs to be informed by science. The Academies have independence and are protected from political influence (Saner 2016). Indeed, the National Academies do a thorough job synthesizing evidence, and offer reports on a series of relevant issues such as biodiversity and climate change, AI in health and medicine and genetic modification, to name a few (The National Academies 2025).

While the use of academies and committees ensures independence of the experts, the reports might take one to two years on average, rendering the process useless for situations when a science-informed decision needs to be made quickly (Saner 2016). It also creates a formal barrier for the policy-maker to engage in an open conversation with the advisor and feel comfortable to ask 'silly' questions.

Most experts and studies agree that there is not a 'one size fits all' model. Some authors express a clear preference for the CSA model (Hutchings and Stenseth 2016), while others try to balance pros and cons of different models, and contend that the choice of the model depends on culture, government arrangements and the approach to policy-making of each country (Doubleday and Wilsdon 2012; Saner 2016; Gluckman et al. 2021). One public officer summarized it well: '*In short, it all depends on the level of development, and also the level of trust of your society, towards democracy and towards science and institutions. If your country has been built on a strong scientific tradition, you look at the scientists, you value them, and you want them to be involved in providing advice*'.

4.2 Skills and competencies

Our participants agree that the role of a CSA relies on personal trust and openness, and requires strong interpersonal skills and the ability to synthesize evidence in a clear and concise format. Previous studies pointed out the need of advisors to be strong communicators, acting as brokers and intermediates (Gluckman 2014; Gluckman et al. 2021; Pielke 2007; Wilsdon 2014).

Skills and competencies of a CSA (Tables 3 and 4) seemed to be a point of consensus to our participants, as were challenges and tensions in the job (Table 5). Haynes et al. (2012) conducted a set of interviews with civil servants in Australia about what they consider to be the most important

competencies and abilities in a science advisor. Policy-makers in general came up with the following list: *'competence, integrity, independence and benevolence'* (Haynes et al. 2012 p. 1). Some examples given by the authors include the need for experts capable of moving away from pure research and into the 'messy real world', the ability to communicate in plain language and without jargon, being trustworthy and independent, and being transparent. Australian civil servants also preferred to work with scientists who possessed some understanding of government processes, bureaucracy, public health infrastructure and parliamentary processes. Other authors also point out the need to have science advisors who can act as intermediaries, brokers and communicators, noting that most of the time they will need to give advice in areas other than their expertise (Pielke 2007; Wilsdon 2014). Clearly, science advising requires a skill set beyond scientific knowledge alone.

Building a relationship with the Prime Minister or President and members of cabinet based on trust and respect was also mentioned in nearly all our interviews. While it may sound obvious, many interviewees pointed out that it is impossible to do the work if you do not have the trust of the person in government. This is in accordance with the most recent literature. Addressing uncertainty, communicating with transparency and avoiding the simple use of data and information without attention to context and public perception are also mentioned in several reports and guidelines (Gluckman 2014; European Commission: Joint Research Centre et al. 2023; The British Academy 2024).

Having a clear understanding of the policy process and ecosystem was also highlighted by our participants, and is described as an important skill (Haynes et al. 2012; European Commission: Joint Research Centre et al. 2023; *Nature*. 2024; Scharfbillig et al. 2024). Cairney and Oliver (2020) argue that advice to academics on how to impact policy-making is mainly vague and superficial, emphasizing that we need science advisors skilled in writing reports that are short, concise, available in plain language, avoiding the usual jargon found in peer-reviewed articles. Many of our interviewees pointed out that they had no previous training for the job, and had to learn it on the go. Some had experience in industry that was useful to understand the use of science in different ecosystems, some had been in administrative positions before and had management skills, but none had specific training in knowledge synthesis and translation, or how to communicate effectively with different audiences. A policy expert noted: '*You need to understand the policymaking process, you need to understand the public administration culture, how to establish collaboration with many different actors, stakeholder engagement and stakeholder management, citizen engagement, communication, science communication that is tailored to the needs of the public administration - how to frame the policy issue in such a way that you can provide the evidence that fits really the needs of that policy problem and so forth*'.

Recently, the European Commission and the Joint Research Centre, the European Commission's science and knowledge service, published a multi-country survey on Science-for-policy ecosystems through the eyes of professionals (Scharfbillig et al. 2024). The respondents all agree on the need for better skills, knowledge translation capacities and institutional support, if we want to advance in the use of science for policy. Similarly, the *Nature* suite of editorials published in 2024 emphasizes the need to train scientists to advise governments. Although there are some fellowships and internships in science for policy such as the American Association for the Advancement of Science (AAAS) fellowship (AAAS 2023) and the INGSA program (INGSA 2024), there are still few opportunities for formal training and degrees in science advisory, and a recent evaluation of research policy fellowships in the UK showed that participants enjoyed the fellowship but feel that more training is needed for long term impact in their careers (Benson-Egglenton and Flinders 2025).

There are, however, recent studies showing an increasing interest of early-career scientists in bridging this gap and acting as science advisors. Many young scientists, although passionate about their fields, prefer not to pursue a career in academia or industry but rather to go into civil service and policy, and serve society not with research, but with knowledge translation (Chanvillard et al. 2024; Schafer 2024).

5. Conclusions

Our work shows the CSA model as a possible strategy to advise governments at many levels, be it at the top, advising Prime Ministers or President directly, or coordinating teams of science advisors in government departments, and also state and local levels. Our interviews helped us to identify basic skills and competencies necessary for the job, and to draw an outline of what the job encompasses. Science advisory requires a distinct set of skills, such as the ability to synthesize and translate scientific evidence and communicate it effectively, a clear understanding of the policy process and how and when science should be used to inform it. A CSA does not necessarily need to be at the top of their academic careers but should be someone respected by the scientific community. And nearly everyone agreed that the position could benefit from scientists with some degree of formal training in communication and policy. We also note that the CSA model and other advisory models such as committees, national academies and supranational organizations should not be seen as mutually exclusive. It is not a question of either/or, but rather a collaborative effort in which all models can play a role. By understanding how each model works, policy makers can choose and adapt whatever works best. Obermeister (2020) argued that science advisors' learning experience was more deserving of scholarly attention. We hope that this paper is a welcome addition to the literature.

5.1 Limitations

Our work has clear limitations. It is a qualitative approach based on semi-structured interviews, which gives an insight into the opinions of people who have worked as CSA, public officers or policy experts. However, given the subjectivity of the job and the low number of countries with an active CSA, it would be difficult to conduct a quantitative evaluation or survey. We make the case that this is only one model of advisory, and several countries employ committees, boards, or use the science academies. However, we noticed that the CSA model, far from being authoritarian or concentrating power in a single person, paves the way to implement a network of knowledge brokerage to different government departments and sectors, making sure that science is integrated in policy-making. We believe that in providing a better understanding of how the model works, we might help to show that it

can be useful and adapted to different countries, cultural backgrounds and scenarios.

Another limitation is that we refer to a great number of documents from the UK government, and a lot of the research literature also comes from research conducted in the UK or the US. We tried to gather information from as many countries as we could. Some did not reply to our requests, others had limited experience and were just beginning to explore the CSA model. The UK is known as a reference in the use of evidence in policy interactions, and a model for the use of scientific advisory in every level of government. The US also has a strong tradition of science advisory. Countries like Japan decided to build their own advisory model after being counselled by the UK (Sato and Arimoto 2016). It is therefore only natural that the UK model influences other countries.

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Supplementary data

Supplementary data is available at *Science and Public Policy Journal* online.

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