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Developing a Typology of Roles for STEM-Trained Professionals in AI Policy Engagement

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Abstract

This paper explores the roles of STEM (science, technology, engineering, and mathematics) professionals in AI policymaking, addressing the urgent need for informed governance in emerging technologies. With AI's complex sociotechnical impacts, STEM expertise is crucial for balancing benefits and mitigating risks like bias and privacy concerns. Despite their potential influence, the specific contributions of STEM professionals in AI policy remain underexplored. To address this gap, semi-structured interviews were conducted with 15 STEM professionals who have both educational and professional experience in STEM and policy, and have actively participated in AI policymaking. The data revealed two primary role groups: (1) advisors, gatekeepers, and influencers, who leverage their expertise in STEM and policy to guide stakeholders and actively influence policy decisions, and (2) facilitators and brokers, who facilitate connections and manage the flow of information between stakeholders. This typology highlights the varied contributions of STEM professionals to AI governance and policy development.

Keywords: AI Ethics; AI Policy; STEM Professionals; Policy Engagement; Role Ethics

Introduction

A growing number of reports (Gual Soler et al., 2017; NRC, 2010) and demands from the public (Oreskes, 2012) have called for more active engagement from scientists in the policymaking process. For emerging and critical technologies like artificial intelligence (AI), such engagement is not only necessary but also critical to prevent harm or even catastrophes (Brundage et al., 2018) due to its complex sociotechnical impacts, which only creates a demand of STEM (science, technology, mathematics, and engineering)-trained professionals bringing their technical expertise to the policy discussion table to ensure informed and balanced decision-making. And as AI technologies become more deeply integrated across various sectors, such needs for robust and ethical governance and regulation have become increasingly critical. We see how governments and organizations worldwide are grappling with how to develop policies that not only maximize the benefits of AI but also mitigate risks such as bias, privacy concerns, and the potential for job displacement (Taeihagh, 2021). At the heart of this issue, we argue, is the need for informed and well-rounded decision-making that bridges the gap between advanced technical knowledge and public policy frameworks.

STEM-trained professionals are crucial to these efforts. Throughout history, STEM experts have significantly influenced policy through their scientific and technological innovations. Their discoveries and inventions often catalyze changes in policy areas while responding to emerging needs and challenges. Likewise, with their deep understanding of AI technologies, STEM experts can offer invaluable insights into the opportunities and limitations of AI systems, offering critical implications for policy and governance (Stone et al., 2022). For instance, Dr. Fei-Fei Li, a computer science professor at Stanford University, testified before the U.S. House Committee on Science, Space, and Technology, offering insights on AI's societal impact and advocating for ethical guidelines in 2023. Moreover, Jason Matheny, former director of the Center for Security and Emerging Technology (CSET) and current CEO of RAND Corporation, has advised the U.S. government on AI's role in national security and his testimony before Congress informed the National AI Initiative Act in the U.S..

Despite the great potential of their technical expertise for public policy discourse and engagement, as shown in the above examples, the *specific* contributions of STEM professionals in these activities remains ambiguous and underexplored in literature. In addition to professional scientists and engineers whose primary roles remain in research and development with only a "secondary" interest in policy, the experiences of STEM professionals who have transitioned into policymaking roles as active participants have rarely been explored likewise. How do these individuals apply their (technical) expertise to shape policy decisions and implementations, and what roles do they assume compared to traditionally policy-trained professionals?

This paper aims to address these concerns by developing a typology of roles for STEM-trained professionals in AI policy engagement. By categorizing and defining these roles, the study seeks to clarify how STEM experts (or professionals with STEM training) can be more effectively integrated into policymaking processes. Therefore, this paper aims to address the following research question: *What specific roles do STEM professionals in policy-related roles assume in AI policy formation and implementation?*

Literature Review

STEM professionals in policy

STEM professionals have been encouraged to be involved in policy as citizens, experts, and/or "beneficiaries" or recipients of government funds (Boehlert, 2007; Christensen, 2021). Some literature has also argued that scientists can and should play a crucial role in approaching and shaping public issues by providing more accurate, scientific information to policymakers and the public. Such an approach unveils the dual role of scientists in both research and policy, suggesting an inseparable perspective in which scientists bear equal accountability in both domains (Gundersen, 2018). In practice, STEM professionals have long played a crucial role in shaping policy, whether by contributing to scientific and technological advancements that lead to policy discussions and implications, or by taking on more direct roles in policy engagement through approaches such as policy advising or working in policy domains.

More specifically, to understand their participation, scholars have developed a framework that outlines two ways in which scientific expertise and policy can interact: *science for policy* and *policy for science* (Gundersen, 2018; Mendoza-Garcia et al., 2012). *Science for policy* aims to assist the creation of policies to address social issues by offering scientific insights, while *policy for science* aims to improve policies that affect science and technology (Renn et al., 2019; Mendoza-Garcia et al., 2012). For instance, using climate change models to develop environmental regulations or health data to shape public health policies are examples of science for policy. Alternatively, formulating national research funding policies or regulations that govern research ethics and data management are examples of policy for science. In discussing the role of STEM professionals in this paper, we address both approaches to expertise and policy. In other words, the roles we are exploring among STEM professionals involve not only the application of their expertise and STEM training in policymaking but also their involvement in shaping policies for the governance of emerging technologies, such as AI.

Below, we review prominent theories on the roles of STEM professionals and their expertise in policy engagement, focusing particularly on Pielke's (2007) typology, Jasanoff's fifth branch theory (1998), Gieryn's boundary work (1983), as well as Abbott's (1988) system of profession. We then explore other more diverse and engaged roles for STEM professionals and conclude with a discussion on the gaps in the existing literature regarding their involvement in policy.

Frameworks for STEM Professionals' Roles in Policy

The role of STEM professionals in policymaking varies, and several frameworks help categorize their involvement. Pielke's (2007) typology maps out four possible roles professional scientists, who oftentimes spend their careers in science while providing science advice to the government and the public, can assume in policy: (1) the *Pure Scientist* focuses solely on research and producing knowledge, avoiding any engagement in policy or political processes, (2) the *Science Arbiter* answers specific factual questions posed by decision-makers but avoids making policy recommendations; the goal is to provide clarity and reduce uncertainty about scientific questions without influencing decisions directly, (3) the *Issue Advocate* explicitly advocates for a particular policy or course of action, drawing on their scientific expertise, and, finally, (4) the *Honest Broker* who expands the range of policy options available to decision-makers by presenting different scenarios and their scientific implications in an unbiased manner.

Pielke's framework highlights the diverse ways in which STEM professionals can engage with policy. This ranges from providing purely technical expertise, such as experts on vaccine safety panels convened by the World Health Organization (WHO) who provide scientific reviews of vaccine efficacy and side effects but do not advocate for specific vaccination campaigns, to actively shaping policy directions. For instance, the Intergovernmental Panel on Climate Change (IPCC) provides policymakers with a range of scenarios based on different levels of global temperature rise, thereby shaping approaches to addressing climate change.

In contrast to Pielke's work on professional scientists' roles in policy, Jasanoff's (1998) theory of "the fifth branch" provides a more detailed interpretation on their more direct involvement in policymaking, particularly through their role as science advisors to the government. It builds on the traditional concept of the *three branches of government* (legislative, executive, and judicial) and the *fourth branch*, often associated with the press that hold influence over governance. She describes how STEM professionals function as science advisory bodies within government, emphasizing their unique position as intermediaries between science and policy. In her theory, science advisors are not just neutral conveyors of scientific knowledge; they also interpret and translate this knowledge in ways that align with broader societal and political values. This perspective shifts the focus from a purely technical role to one that acknowledges the normative dimensions of scientific advice. Jasanoff (2004)'s concept of co-production further elaborates on this idea, suggesting that scientific knowledge and social order are co-produced, with STEM professionals playing a crucial role in shaping not only the content of policies but also the values and norms that underpin them. An example of this advisory role is the President's Council of Advisors on Science and Technology (PCAST), initiated under President Biden, which exemplifies the latter pathway. PCAST consists of advisors from outside the federal government who are tasked with making science, technology, and innovation policy recommendations to the President and the White House.

Thomas Gieryn's (1983) theory of boundary work, on the other hand, gives us a critical lens for understanding how professionals such as scientists strategically, and ideologically, demarcate science from non-science. In public controversies, more specifically, scientists engage in discursive practices to define what counts as legitimate expertise, who is authorized to speak, and what methods are deemed credible. These boundaries are not fixed but are mobilized to suit particular institutional, political, or epistemic interests. In policy settings, boundary work is often used to protect scientific authority, especially when science is challenged by political ideologies, commercial interests, or lay expertise. Gieryn's theory is especially potent in showing the performative and rhetorical dimensions of STEM professionals' public engagement, as well as how expertise is always at risk of being politicized or undermined. While not prescriptive, boundary work theory provides critical tools for analyzing credibility management and the symbolic power of science in democratic societies.

Finally, Andrew Abbott's *The System of Professions* (1988) shifts the analytical lens from individual roles and discourses to the collective behavior of professional groups. He argues that professions operate within a dynamic system where they compete for jurisdiction over problems, tasks, and knowledge domains. Jurisdiction refers to the claim to legitimate authority over a particular area of social concern, be it medical care, legal regulation, or scientific advice. Applied to STEM professionals in policy, Abbott's framework helps explain why and how scientists and engineers assert control over certain issues, often in competition with lawyers, economists, and public administrators. Jurisdictional claims are shaped by public trust, organizational structures, and responses to crises. For example, the rise of AI has prompted new jurisdictional contests between computer scientists, ethicists, and legal experts over algorithmic accountability. Abbott's emphasis on institutionalization and professional autonomy offers a broader structural context for understanding how STEM professionals attempt to expand, defend, or lose influence in policy arenas.

Collectively, these four frameworks offer conceptual toolkits for studying the evolving roles of STEM professionals in policy. Pielke's typology provides a normative vocabulary to classify individual orientations to policy influence, while Jasanoff's institutional analysis reveals how these roles play out under conditions of uncertainty and legal accountability. Gieryn's boundary work attends to the discursive construction of scientific legitimacy. Lastly, Abbott's theory zooms out to examine the meso-level competition among professions vying for policymaking authority.

Beyond advisory roles and its limitations

Beyond advisory roles, STEM professionals also serve in various critical capacities in policy and the government including as regulatory experts (Ashford 1984), policy analysts (Meltsner 1976), and elected officials (e.g. 3.14 Action launched by the Democratic Party in the U.S.). Regulatory experts leverage their scientific knowledge to develop and enforce regulations, ensuring policies are based on the latest evidence and technological advancements. Policy analysts, in contrast, interpret complex data and trends to guide policy decisions, evaluating potential impacts and providing evidence-based recommendations. Furthermore, STEM professionals who become elected officials bring their technical expertise to legislative processes, shaping decisions on science funding, research priorities, and public science initiatives. Although these roles, compared to more common ones such as the advisory role are less frequently discussed and often regarded as "neglected" (Gundersen, 2018), existing literature does highlight the significant contributions of STEM experts in providing scientific evidence and reasoning amid social and political judgments (Boehlert, 2007).

Nevertheless, scholars have identified several limitations associated with involving STEM experts in policy: On the one hand, the complex interplay between science and politics presents a major challenge in navigating the tension between scientific evidence and political considerations. This often leads to conflicts between maintaining scientific integrity and meeting policy demands. As noted by policy analysts, STEM experts' roles are constrained by the availability of the latest knowledge, which may still be ambiguous and uncertain (Renn et al., 2019). Smith (1992) further explores this paradox, highlighting that while scientists are valued for their expertise, their effectiveness is often dependent on conforming to political rules, creating a challenging environment where their influence is subject to political constraints. Additionally, the multifaceted decision-making process and a contested perception of scientific expertise poses another challenge. STEM experts' contributions are often one of many factors considered in the policy decision-making process; their input is often overshadowed by political and economic considerations. Policy experts may view STEM professionals primarily as sources of insight into scientific and technological processes *relevant* to policy goals (Boehlert, 2007). However, when scientific insights are politically inconvenient, they can either become irrelevant or be used against opposing viewpoints, a phenomenon described as "putting [science] on a pedestal and then ripping it down" (Boehlert, 2007, p. 2). Boehlert (2007) further emphasizes that "policymakers have to do their homework about science just as much as scientists need to do some homework about policy and politics" to ensure a more stable and effective role for STEM experts in policy.

Overall, in situations where facts are uncertain, values are contested, stakes are high, and decisions are urgent—similar to what Funtowicz & Ravetz (1993) describe as the era of post-normal science—traditional approaches to defining and categorizing the roles of STEM experts may fall short in addressing complex sociotechnical problems, particularly those involving emerging technologies like AI. Despite the growing interest in the intersection of STEM expertise and policymaking, several gaps remain in the literature. Firstly, it is unclear whether existing typologies of STEM roles are applicable to emerging fields like AI. Secondly, aside from Pielke's typology, which primarily relies on conceptual analysis rather than systematic empirical research, there is a lack of systematic mapping and categorization of the various roles STEM professionals play in policymaking practices. This gap results in a fragmented understanding of how their expertise is utilized. Lastly, the role of entry-level STEM professionals who transition from technical fields into policymaking roles has received little attention. These individuals, although possessing STEM backgrounds, work as policy participants rather than scientists, and their career transitions and contributions are not well-explored in current research.

This study, therefore, aims to address the three gaps. Furthermore, it hopes to bridge the gap between the growing demands for robust AI governance and the active involvement of STEM professionals in this process. We believe that a systematic understanding of the diverse roles STEM professionals can play in policy engagement, particularly regarding emerging technologies, can enhance the effectiveness of their involvement, the integration of their expertise into the policymaking process, and the development of more effective educational and training programs for STEM professionals in policy roles. In the following sections, we will analyze the roles that STEM experts can and do play in shaping AI policy to explore how these professionals can be more effectively integrated into the policy engagement process.

Methodology

Participants

Participants for this study possess at least one academic degree in STEM (bachelor's degree or higher) and are currently engaged in careers involving AI policymaking. A total of fifteen individuals with STEM backgrounds were recruited for this study (see Table 1 for their demographic characteristics). The recruitment process began with the distribution of a survey to alumni of the Christine Mirzayan Science and Technology Policy Fellowship of the National Academies of Sciences, Engineering, and Medicine. The survey collected demographic and career background information. Those who met the established criteria and expressed interest in participating were mostly invited to join the study. Table 1 shows the demographic information of participants who were ultimately included in the study.

Table 1. Demographic Information of Interview Participants

Pseudonym	STEM Background	Sector	Gender	Race/Ethnicity
Benjamin	Neuroscience	Federal Government-Executive	Male	White
James	Physics	Federal Government-Executive	Male	White
Gary	Bioengineering	Federal Government-Executive	Male	Asian
Vera	Computer Science	Federal Government-Executive	Female	Asian
Irene	Computer Science	Federal Government-Executive	Male	White
Julia	Chemical Engineering	Federal Government-Executive	Female	White
Daley	Electrical & Computer Engineering	Policy Think-tank	Male	White
Melissa	Neuroscience	Policy Think-tank	Female	White
Elise	Information Security	Policy Think-tank	Female	Mixed
Stephen	Computer Science	Policy Think-tank	Male	White
Jeff	Other	Policy Think-tank	Male	Black
David	Neuroscience	For-profit Company	Male	Asian
Otis	Computer Science	For-profit Company	Male	Asian
Emma	Chemistry	Other	Female	White
Cynthia	Computer Science	Other	Female	White

Data Collection

Data were collected through semi-structured interviews, each lasting between 60 to 90 minutes, conducted via Zoom. For consistency across interviews, an interview protocol was developed, outlining the key questions to be asked and the format to be followed. The interview consisted of two distinct sections. The first section focused on the participants' career pathways to becoming STEM policy experts. Some of the results from this section were reported in detail in a forthcoming study ([Blind for review]), focusing on mapping the essential skills required for a policy career among STEM professionals. The second section addressed their perspectives on AI ethics policy and practices, and portions of responses from this section were used in this paper to develop a typology of their roles in policymaking. The primary interview questions included in this paper for analysis were: "How do you perceive your role in the ethical development and use of AI within your professional community and the broader society?" and "What are the important ethical issues in AI-related fields frequently discussed in your field of work? How do you address these issues in your daily work?"

Participants often responded to the first question by sharing examples from their daily experiences in policymaking and their self-perceived roles in the ethical development and use of AI. Following these initial responses, the interviewer would use probing questions to further explore specific aspects of their roles. Although more subtle and indirect to the primary research question, the second tier of questions also allowed the researchers to tease out the actions and decision-making processes participants employed in real-world scenarios. As participants shared how they navigate the ethical challenges they encounter, they revealed insights into their roles in their organizations or policy ecosystems.

Data Analysis

Through iterative coding and category refinement, our analysis resulted in five final role categories that structured the presentation of findings. As these role labels are referenced in the explanation of how earlier codes (e.g., "Informant") were consolidated, here we briefly define them for clarity: **Advisors** provide technical and ethical guidance to stakeholders; **Influencers** shape policy agendas and persuade others to prioritize specific ethical issues; **Gatekeepers** oversee ethical alignment and procedural accountability; **Facilitators** often convene multi-party dialogue across domains; and **Brokers** act as intermediaries who transfer knowledge and connect otherwise disconnected actors or groups.

The interviews were audio recorded and transcribed using an external transcription service. Once completed, all transcripts were de-identified, and each participant was randomly assigned a pseudonym. The analysis process began with a detailed review of the transcripts, during which the first and the corresponding authors independently conducted initial coding. This involved closely examining each transcript to identify specific actions, behaviors, and experiences mentioned by the participants. During this phase, segments of the text were assigned code labels that represented key themes or concepts related to the participants' roles in AI ethics policymaking. For example, actions such as "developing ethical guidelines," "advising on AI policy," or "conducting AI risk assessments" were assigned specific codes to capture the essence of each activity.

After initial coding, the research team met regularly to compare and refine codes. Codes that reflected similar functions or responsibilities were grouped into broader conceptual categories. Through iterative discussion, these categories were further abstracted into role-based typologies. In cases where data segments overlapped or could plausibly fit multiple roles, we retained them in both categories during early rounds of analysis and resolved ambiguity through team discussion, considering the participant's intent, context, and emphasis.

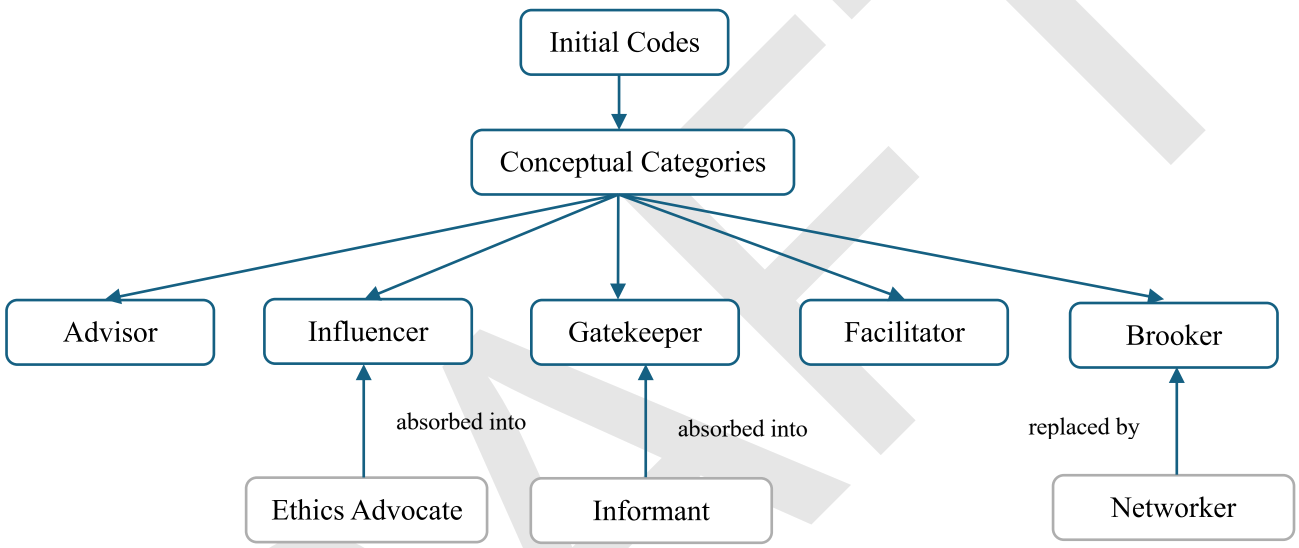
During this process, we also considered and initially labeled additional roles such as "informant," "ethics advocate," and "networker" or "connector." The informant role captured participants' efforts to make visible hidden risks and provide internal knowledge about ethical blind spots in AI systems. While this role initially appeared to be distinct, we ultimately integrated it into the gatekeeper category, as its core functions—advocating for the marginalized and ensuring institutional accountability—aligned closely with the broader responsibilities of gatekeeping. The ethics advocate role, which captured participants' proactive efforts to raise awareness about specific ethical issues, was eventually merged into the influencer category to emphasize the strategic and agenda-setting nature of their advocacy. Lastly, the networker or connector role was renamed broker to better reflect participants' function as intermediaries who exchange information and build bridges across technical, policy, and ethical domains.

We also considered alternative role typologies, including those drawn from science and technology studies (e.g., Pielke's "Honest Broker" framework), but found that our emergent categories better captured the hybrid nature of STEM professionals' engagement in AI ethics.

Disagreements between the two coders were resolved through collaborative discussion and consensus building. When consensus could not be reached immediately, we revisited the transcript context and consulted memos to ensure interpretive consistency.

Finally, each role was given a distinct label and description in a code book. This codebook guided the final round of coding and ensured consistency across transcripts. A simplified data structure diagram (see Figure 1) illustrates how initial codes were organized into categories and synthesized into the final role typology.

Figure 1. Data Structure



Establishing Trustworthiness

To ensure validity and credibility, several strategies were employed in this qualitative study. Firstly, inter-coder checking was conducted, where the first and the corresponding authors in this project independently coded the transcripts and compared the roles that emerged to ensure consistency. Triangulation was also applied by cross-referencing data from interviews and existing literature on the key roles assumed by policy professionals, which helped validate the findings from different sources (Creswell & Poth, 2018). Additionally, thick descriptions were used to offer rich, detailed accounts of participants' experiences (Tracy, 2010). All together, these approaches enhanced the study's overall reliability and validity.

Findings

The roles of AI professionals in shaping the ethical governance of technology, emerged from the data analysis, could be driven by two factors: (1) their interdisciplinary backgrounds or expertise; and (2) strategic positions within their organizations or networks. These roles, as we discuss more in this section, ranging from advisors and educators to gatekeepers, influencers, facilitators, and brokers, are essential in guiding the ethical development and deployment of AI technologies. Below, we explore how these roles can be divided into two key categories: those focused on guiding and educating stakeholders given their specific interdisciplinary backgrounds, and those centered on facilitating connections and influencing discussions across various organizations and networks. Tables 2 and 3 present the two groups of roles, each illustrated with representative examples drawn from the data.

Table 2. Typology of Roles: Roles Related to Interdisciplinary Expertise

Role	Description	Examples
Advisor Role	educating and guiding stakeholders especially AI developers, offering insights while respecting their autonomy in decision-making	• Clarifying implementation challenges for policymakers • Educating AI developers about ethical boundaries • Helping others understand how policy applies to their work • Serving as counselors drawing on both industry and STEM experience to guide others
Influencer Role	taking a more proactive and yet strategic approach, actively shaping ethical discourse and policy agendas to prioritize pressing concerns	• Advocating for underrepresented ethical issues in AI policy discussions • Persuading stakeholders to prioritize specific risks or values • Framing technical concerns in ways that highlight their ethical or societal implications • Using dual STEM-policy expertise to influence the direction of regulatory conversations
Gatekeeper Role	assumes a more institutional and protective stance while overseeing processes to ensure ethical standards are upheld and that inclusivity is embedded in AI development	• Ensuring ethical review processes include overlooked or marginalized perspectives • Raising critical questions about data use, harm, or inclusivity in institutional settings • Monitoring compliance with ethical guidelines in AI research or deployment • Acting as institutional safeguards to prevent harm or exclusion in AI systems

Table 3. Typology of Roles: Roles Related to Facilitating Connections

Role	Description	Examples
Facilitator Role	creating platforms for communication and collaboration among diverse stakeholders in the development and deployment of AI	• Convening diverse stakeholders to discuss ethical implications of AI • Setting agendas for cross-disciplinary conversations on AI governance • Promoting shared understanding across technical and policy communities

		• Encouraging inclusive dialogue by keeping ethical terms broad and open-ended
Broker	proactively building connections between individuals from diverse communities in ethical discussions and decision-making processes, as well as managing information exchanges among them	• Acting as liaisons between technical experts and policymakers • Translating stakeholder concerns into actionable insights for other groups • Holding and distributing information across institutional or disciplinary boundaries • Building bridges between AI developers and international policy communities

Roles Related to Interdisciplinary Expertise

Each role is primarily driven by their interdisciplinary backgrounds, training, and expertise in both STEM and policy. These roles shape their daily discussions and practices surrounding the ethical governance of AI within professional settings. In the evolving landscape of AI ethics, professionals often take on distinct yet complementary roles to ensure responsible innovation. Three such roles—advisor, influencer, and gatekeeper—highlight the varied ways ethical expertise is applied in policy practices. Overall, the advisor primarily focuses on educating and guiding stakeholders especially AI developers, offering insights while respecting their autonomy in decision-making. In contrast, the influencer takes a more proactive and yet strategic approach, actively shaping ethical discourse and policy agendas to prioritize pressing concerns. The gatekeeper, meanwhile, assumes a more institutional and protective stance, overseeing processes to ensure ethical standards are upheld and that inclusivity is embedded in AI development. Together, these roles reflect a spectrum of ethical engagement, from supportive mentorship to proactive advocacy and structural oversight.

Advisor Role

This role involves providing guidance and education to scientists, industry, and the public seeking consultation on ethical issues. Advisors ensure that these stakeholders understand ethical boundaries and considerations. More specifically, participants' interdisciplinary backgrounds, training, and expertise in both STEM and policy provided knowledge and practical experience required by their role as advisors and educators. This dual nature of the expertise allows them to advise and educate diverse stakeholders on complex ethical, technical, and policy challenges surrounding AI in a more technically sound and ethically aligned way. As highlighted by Otis, an industry professional with a background in computer science,

> My role is more of an advisor, a counselor, because coming from the industry and having a background in STEM, I understand the impact... I'm not a policy maker, but I'm…an advisor.

Their daily obligations as advisors could also be found in statements by Gary, a federal government executive with a background in bioengineering, who emphasized the importance of educating individuals participating in AI development and deployment to understand the ethical rules and guidelines for their own work. By doing so, individuals involved in AI development can ensure that their responsibilities and decision-making processes within their respective domains are conducted in alignment with ethical principles. A key objective of serving as an advisor in this context is to mentor AI developers by bridging gaps in their understanding of ethical guidelines and the broader implications of AI innovation, thereby facilitating ethical decision-making aligned with their moral responsibilities. As noticed by Gary,

> So what I see my role on a day-to-day basis... is making sure that those folks understand what the rules are so that they can do their work as best as possible. So they know what the limits are. And if they understand that these conversations are happening so that they can predict that and not kind of make or not start writing checks that they can't cash, right?

Emma, Elise, and Stephen also highlighted their major responsibility as advisors, emphasizing the importance of discernment, critical conversations, and even their roles in challenging policymakers. For example, Emma, a nonprofit sector professional with a background in chemistry, noted her role in advising people: "So again, I would advise people, have discernment, okay? Have discernment, think and ask questions." Elise, a policy think-tank researcher with a background in information security, on the other hand, discussed her advisor role in engaging with teams on ethical implications: "And so I will have a lot of conversations with people over at the bio team... Well, what are the risks there about pointing out this researcher who is here in the US, but is from this other country..." Similarly, leveraging his experience and expertise in AI policy, Stephen, a policy think-tank researcher with a background in computer science, assumed a role primarily involved educating AI stakeholders in AI development, such as policymakers and companies, about the challenges and consequences of implementing specific regulations and policies:

> And the sort of broad theme in what I do is that I think a lot of policymakers are kicking the can sort of further and further down the road... So that's sort of how I envision my role right now is trying to outline exactly how the implementation is difficult and what that means for all the parties involved.

In summary, the advisor leverages STEM professionals' expertise in both STEM and policy to educate various stakeholders—who may lack this expertise—encouraging them to critically consider the (ethical) consequences of AI research and innovation.

Influencer Role

Unlike the more neutral advisor, the influencer—similar to Pielke's "policy advocate"—actively steers ethical conversations, ensuring that pressing issues are brought to the forefront of scientific and policy discussions. This role shapes the decision-making process by introducing ethical knowledge, surfacing overlooked concerns, and setting agendas that prioritize the needs of marginalized or affected groups. While the advisor role primarily focuses on bridging knowledge gaps among AI developers—respecting their autonomy in making independent decisions—the influencer role adopts a more proactive stance, shaping the policy agenda through strategic engagement, discussions, and collaborations with AI professionals.

For example, Cynthia, a nonprofit sector professional with a background in computer science, emphasized the importance of leveraging her dual knowledge backgrounds in STEM and policy to actively contribute to ethics discussions and policymaking processes: "I contribute as much as I can whenever I find the opportunity... I feel a responsibility because of my background... to help make ethically responsible decisions." By the same token, Daley, a policy think-tank researcher with a background in electrical and computer engineering, shared his role in advocating for specific issues and about the importance of certain ethical considerations: "Part of my work is trying to be a little bit of an advocate and persuade policymakers... that certain problems are important or deserve more attention."

In addition, David, an industry professional with a background in neuroscience, discussed his role in influencing stakeholders especially their clients in discussions and ensure that they understand the "gray zone" they may be stepping into:

> I think I am in a position to influence decisions within my company and my clients… So I think it's important for me to understand what's the ethical boundaries of AI, and that's where we operate in. If we have to go beyond that, I think we have to be very clear to ourselves, to our client, and say, "We are moving into the gray zone right now. I'm not comfortable in doing this because these and that reasons." I think that's probably the most practical thing to do.

Comparatively, the influencer role assumed by Benjamin, a federal government executive with a background in neuroscience, involved setting up an ethical agenda by strategically influencing conversations and fostering awareness in his interactions with AI professionals. As he mentioned, within the conversation that he had with people from a prestigious private university who studied AI and wrote policy briefs for the White House, he was planning to

> [go] into this with an agenda...to influence them to care about the things that we think are important when it comes to AI policymaking. So that is for sure also just to exchange learnings with them. But the agenda there is to be persuasive about the issues that we really think are important so that other people can then go work on them.

Overall, the diverse strategies and approaches influencers employ serve to actively promote ethical awareness, shape ethical discourse, and influence decision-making processes within their respective fields. Unlike the gatekeeper role described below, who relies on institutional authority or formal oversight mechanisms, the influencer role shapes ethical priorities primarily through persuasion, agenda-setting, and strategic communication.

Gatekeeper Role

This role involves overseeing and safeguarding the ethical alignment of processes, topics, and work conducted by AI engineers. Gatekeepers also ensure all involved parties have a voice in AI ethical decision-making. More specifically, the scope and approach of gatekeeping can vary—from enforcing ethical requirements to advocating for marginalized or affected communities when developing AI systems. Given that AI engineers may exhibit different levels of ethical sensitivity toward the implications of the technology they are working with, the role of a gatekeeper is essential in ensuring responsible and ethical practices in AI research and development. Compared to the advisor role, which educates and guides AI developers while respecting their autonomy, and the influencer role, which strategically shapes ethical discourse and policy agendas, the gatekeeper role is defined by its responsibility to oversee, safeguard, and enforce ethical standards and inclusivity in AI development. Unlike advisors or influencers, gatekeepers often operate within or alongside institutional frameworks—such as research ethics boards, corporate compliance teams, or policy review bodies—where they are responsible for upholding ethical standards and ensuring that AI development processes are inclusive and accountable.

Beyond enforcing ethical standards, gatekeepers often serve as ethical navigators—operating in gray zones where formal rules may be lacking. Their authority is often situated within institutions, but their influence also stems from their ability to raise critical questions, protect vulnerable groups, and ensure that ethical concerns are not sidelined in the rush of innovation. James, a federal government executive with a background in physics, explained his role, especially in the presence of other AI ethicists, is to "oversee some of that work, but ... not [claim] to read all the breadth of publications and things that are going on in the research space but to have a team that keeps those things in mind." Julia, a federal government executive with a background in chemical engineering, emphasized the importance of asking critical, often overlooked questions that go beyond traditional ethical considerations in her role as a gatekeeper. As she stated,

> Have these kinds of questions been included in an IRB (Institutional Review Board) review? Well, if I produce a product that maybe doesn't see everyone the same way, is that the same kind of harm to humans? Well, I don't know, unless we talk about it, right? So at this point, I think my primary ability to actually make change and influence in this space is by ensuring that certain questions get asked. So how is this going to be used? What do we think? What are the consequences of this? What happens if you all lose the dataset you've just built, right? How do we protect people's identities? Whatever it might be.

While Julia's role emphasizes internal questioning and ethical reflection, others like Benjamin and Jeff extend the gatekeeper role into the realm of institutional advocacy—working to build systems of accountability and recourse for those most at risk of harm. Benjamin and Jeff offered a more proactive interpretation of the gatekeeper role in advocating for the marginalized and ensuring inclusivity in AI policymaking. Benjamin described this role as being "the adult in the room" to ensure positive outcomes for those who often lack a voice in technology development and to serve as "avenue for recourse":

> There's no one to complain to, basically. There's no institution that is going to protect them in the face of that discrimination. And so that's the kind of thing that we also do, is just trying to build up those institutions so that people have some avenue for recourse if they've been harmed by an algorithmic system.

In the same vein, Jeff, a policy think-tank researcher with a general STEM background, acknowledged his role as "protective factors" that help scientists to "[think] through credit scoring, [think] through mortgages, [think] through their access to healthcare, [think] through their access to a set of social rights" given that he believed when it comes to the development of AI. More specifically, he saw his role as assuming a safeguarding position to ensure that AI development becomes a more inclusive process. As he stated,

> The question is about the distribution of those innovations and the safeguards that makes for a more expansive and inclusive process, rather than a commodification that then is priced at a premium where only folks who can afford to pay will then be able to participate more fully.

Collectively, these insights highlight the multifaceted nature of the gatekeeper role—encompassing ethical oversight, advocacy for inclusivity, and the promotion of informed, responsible decision-making. Their role is inherently preventative, aiming to identify and mitigate ethical risks before they materialize in AI systems, ensuring that harm is avoided rather than merely addressed after the fact. At the same time, participants' reflections reveal the tensions gatekeepers often face—balancing institutional constraints, technical priorities, and ethical imperatives in environments that may resist change. The gatekeeper role ensures that AI development meets fundamental ethical requirements, whether these involve preventing AI technologies from causing harm to individuals or ensuring the inclusion of diverse perspectives. Whereas the influencer role often shapes conversations and priorities from the outside through persuasion, the gatekeeper role operates from within institutions and it uses procedural authority to monitor, approve, or block actions to ensure ethical alignment.

Roles Related to Facilitating Connections

The roles of facilitator and broker are inherently tied to their positions within their social networks for AI policymaking, specifically occupying what is known as a "structural hole" (Burt, 1992) Structural holes refer to gaps between different groups or individuals within a network where there is a lack of direct connections. These "structural gaps" create opportunities for individuals or entities to act as bridges or brokers between otherwise disconnected groups. The roles of facilitator and broker leverage their unique positions to bridge gaps, facilitate connections, and facilitate information exchange between different groups or individuals within different networks.

Facilitator Role

This role involves creating platforms for communication and collaboration among diverse stakeholders in the development and deployment of AI. Facilitators foster discussions on ethical topics and encourage cross-boundary dialogues. For example, Julia emphasized convening power as a key aspect of her role: "So one of the things I can do really well is have people meet together and talk about stuff, and I can set the agenda of what they talk about", and she continued to share the importance of communication:

> And often, by us generating those conversations, bringing those groups of people together, it will get bigger and broader interest because you're, "Oh, why are they so focused on that? Maybe we should think about what that's about," or, "We want to be part of that conversation next time." And kind of build that conversation.

Similarly, Melissa, a policy think-tank researcher with a background in neuroscience, stated the importance of laying groundwork and ensuring that all stakeholders are on the same page, and highlighted the facilitator's role in promoting shared understanding and mitigating information asymmetry among stakeholders. She said,

> I do think we really need just some work to lay the groundwork, to get everybody on the same page... And I think that's what I want to... We're getting started on that work now… Just to try to build some of those bridges, have the sort of smaller conversations to avoid the information hazard. But yeah, to have the discussions about how they're converging, what those implications are, and what are some of the options that we can pursue to decrease the risks.

Interestingly, facilitating dialogues is not only about having a platform but also about how policymakers strategically set the agenda. Vera, a federal government executive with a background in computer science, emphasized the importance of maintaining a flexible understanding of “ethics” to gain valuable insights from experts in the field. As she stated,

> ... since it is such a broad terminology, ethics, so what we’re trying to do at this moment is within professionals who are involved in AI ethics, we're listening how they define ethics and what are some ethical issues that they think are most frequently discussed so that for us to conceptualize ethics based on the experiences of the AI professionals like you. So that is the reason why. At this moment, I use the term as broad as possible without specific definition so that I can learn from the professionals who are actually involved in such a network.

As this demonstrates, using a broad and ambiguous definition of “ethics” can help engage a wider audience in the discussion of AI ethics from different perspectives and professionals with diverse expertise.

Here, we observe how the role of facilitator, positioned as a structural hole within the network, serves to bridge the gap between experts from various realms. This bridging facilitates more informed decision-making and even aids in mitigating information hazards. Unlike the broker role (articulated below), who engages in targeted one-to-one exchanges to move information across organizational or disciplinary boundaries, the facilitator role focuses primarily on convening group dialogue and creating shared discussion spaces.

Broker

This role involves proactively brokering connections between individuals from diverse communities in ethical discussions and decision-making processes, as well as managing information exchanges among them. Compared to facilitators whose major job is to establish dialogue platforms among diverse parties, brokers proactively broker the *effective* exchange of information among them. Here, the role of a broker extends beyond simply connecting people; by “brokering”, we argue that it involves holding information, facilitating exchanges, and fostering meaningful changes. Brokers also serve as intermediaries and liaisons between different groups, actively engaging with stakeholders to understand their perspectives, concerns, and priorities.

For instance, Benjamin talked about the importance of reading reports, having regular discussions, and understanding what stakeholders consider to be the most important issues in fulfilling his broker role. He stated, “[his role] means reading their reports that they put out and having regular discussions with them and trying to figure out what they think are the most important issues and why.”

Gary, stated that since his daily work included a great amount of time at some of those other agencies, he therefore identified himself as a liaison between these groups, emphasizing the importance of communication and conversation in his role:

> I do see myself in some ways as kind of a liaison between the groups... communicating as best as I can and having conversations as best I can with as many people as possible, in addition to our center in [city X] that’s working on these issues, so that the regulators

> kind of have as good an idea of what's being worked on, and what are the problems we're trying to solve with AI.

Daley also shared that creating a "bridge" between technical AI experts and the international policy world is crucial:

> But I think making a bridge between people who think about things from more of a technical AI-centric perspective and creating a bridge to the international policy world is just as important because it's so much kind of less thought about, less understood.

In conclusion, brokers play a crucial role in connecting diverse communities in shaping the ethical aspect of the development of technologies. They, with their unique, strategic position in the network, hold information, facilitate exchanges, and foster meaningful changes, as demonstrated by the interviewees. Whereas the facilitator role creates spaces for collective conversation, the broker role functions more actively across structural gaps, initiating individualized exchanges and transferring information between parties who would not otherwise interact with each other.

Discussion

The roles of STEM background professionals in shaping ethical AI governance, as identified in this study, can be categorized into two primary groups. The first group includes those that focus on employing STEM and policy expertise to educate, proactively influence, and oversee stakeholders; these are advisors, influencers, and gatekeepers. In contrast, the second group comprises facilitators and brokers who use their positions in their organizations and networks to foster connections, facilitate discussions, and manage information flows across various groups.

Advisor roles played by STEM professionals in policymaking fields have been extensively discussed in the literature. Various institutions, including think tanks (McGann, 2007) and broader policy advisory systems (Craft & Howlett, 2013), have been explored for their contributions to policy guidance. Some research has specifically focused on the roles of STEM professionals in these contexts. For instance, Brown et al. (2009) and Spruijt et al. (2014) argue that STEM experts should adopt different roles depending on the nature of the problem and factors such as the values they hold and the type of knowledge they contribute. However, our study reveals that advising or educating in these fields is not a unidirectional, linear process in which government bodies merely seek technical knowledge from STEM experts. Instead, the professionals in our study, who assumed policymaking roles, provided advice not only to government bodies but also to other AI engineers with STEM backgrounds. Their interdisciplinary backgrounds in both STEM and policy enabled them to grasp the technical aspects of AI while also offering "insider perspectives," thereby providing nuanced advice on the ethical issues that STEM experts involved in AI development may encounter.

The influencer role—where STEM professionals proactively and strategically shape the ethical discourse around AI—closely aligns with Pielke's concept of the "issue advocate." This role has been the subject of various discussions regarding scientists' advocacy in policy, as explored by Nelson & Vucetich (2009) and Donner (2014). Echoing their arguments, our findings reveal that participants, drawing from their STEM backgrounds, are keenly aware that certain AI scientists, engineers, and policymakers may not even recognize or be attuned to the existing ethical concerns within their fields. This makes the role of influencers particularly important, as they must actively highlight and address these overlooked issues. Influencers in AI governance shape decision-making by providing essential technical and ethical knowledge, raising awareness about previously unnoticed ethical dimensions, and setting agendas that prioritize specific ethical concerns related to AI innovations. Such a role helps ensure that ethical considerations become central to AI design and the associated policymaking processes.

Finally, the gatekeeper role, though less frequently discussed in the literature, is crucial in ensuring that AI development aligns with fundamental (often minimal) ethical standards. Existing studies raise concerns about how effectively AI ethics principles can be integrated into real-world practices, exploring options such as human oversight (Morlet et al., 2021) or frameworks such as ethics-as-a-service (Zhou & Chen, 2020). We argue that the constant involvement of professionals with interdisciplinary expertise in both technical and ethical/policy dimensions – such as those in gatekeeper or overseer roles – is essential for achieving such a goal. In addition, our findings suggest that gatekeeper roles can vary in scope and approach. These professionals may oversee adherence to ethical guidelines and ensure that all stakeholders have a voice in ethical decision-making. Their involvement not only helps ensure AI's ethical alignment but also brings a critical perspective that prioritizes inclusivity and fairness in AI governance.

The second category of roles—facilitator and broker—is similarly complex, particularly within the context of AI policymaking. These roles align with Burt's (1992) concept of "structural holes" in the social network theory, where professionals act as intermediaries, connecting otherwise disconnected groups and facilitating the flow of information between them. In AI governance, these individuals play crucial roles by bridging gaps between policymakers, technical experts, industry representatives, and the civil society. Facilitators and Conveners create platforms for communication and collaboration among diverse stakeholders involved in the development and deployment of AI. They foster discussions on ethical topics and encourage cross-boundary dialogues so that AI policy discussions are not siloed within specific disciplines or sectors. In this way, facilitators help prevent fragmented or insular discussions that could lead to policy blind spots, particularly in areas related to AI ethics, safety, and societal impacts.

Brokers, then, take a more proactive approach in enabling the effective exchange of information between these groups. Like the concept of a "knowledge broker," which focuses on how knowledge is mediated and transferred in the policymaking process, these roles emphasize the importance of facilitating the flow of expertise and information between different stakeholders (Bandola-Gill & C Lyall, 2017; Gluckman et al., 2021). In our study, the role of broker played by our participants also involves actively ensuring that key information, concerns, and insights are shared between stakeholders who may not otherwise interact. This role is particularly important in the rapidly evolving field of AI, where the pace of technological advancements often outstrips the ability of policymakers to keep up with the latest developments.

In contrast to Pielke's four roles of scientists in policymaking, the roles identified in this study adopt a more proactive and normative stance. Specifically, neither the Pure Scientist nor the Science Arbiter in Pielke's framework is truly active; the Pure Scientist refrains from engaging in policy or politics, while the Science Arbiter only responds to factual questions posed by policymakers. This study, building on insights directly gleaned from the STEM background practitioners working in policy fields, expands beyond Pielke's four roles; the roles identified in this study reflect the perspectives of individuals actively pursuing policy careers. Furthermore, the four roles in Pielke's framework are relatively individualistic, primarily focusing on the specific contributions of scientists as individuals to policymakers. In contrast, the roles identified in this study—particularly those in the second group—emphasize how STEM professionals can serve as nodes within a system that connects various stakeholders. This perspective highlights the collaborative and mediating nature of their engagement in policymaking processes.

However, admittedly, there are overlaps between the other two roles in Pielke's framework and the roles identified in our study. For example, the Issue Advocate role in Pielke's framework closely parallels the Influencer role in this study. Similarly, the Honest Broker role in Pielke's framework largely overlaps with the advisor role identified here, as both involve utilizing scientific expertise to inform policy options and their associated technical implications and consequences for other stakeholders in the policymaking process.

On the other hand, our analysis, which goes beyond the "fifth branch" concept that primarily focuses on advisory roles, resonates with Jasanoff's concept of co-production. In this context, STEM professionals working on AI policy leverage their scientific and technological expertise—alongside their beliefs—to actively shape and be shaped by the broader social and ethical values related to AI innovations. Rather than serving as passive advisors, participants actively embed normative assumptions, such as fairness, accountability, and inclusivity, into the policy infrastructures they help design or influence. Through their strategic engagement in agenda-setting, ethical framing, and institutional design, they contribute to the co-production of sociotechnical imaginaries that envision AI not just as a technical system, but as a socially embedded and morally accountable innovation. This dynamic reflects Jasanoff's argument that scientific knowledge and social order are co-produced, emphasizing the interplay between expertise and societal norms in the policymaking process.

Finally, a critical overarching finding of this study is that STEM professionals in policy-related roles actively engage in constructing and defending their authority within ethically contested policy arenas. This dynamic is particularly well illuminated by two sociological frameworks mentioned earlier: Gieryn's (1983) theory of boundary work and Abbott's (1988) theory of the system of professions, both of which offer valuable insights into how expertise is negotiated, legitimized, and institutionalized in complex governance contexts.

One the one hand, Gieryn's (1983) theory of boundary work provides a valuable framework for understanding how all five roles identified in this study—advisors, influencers, gatekeepers, facilitators, and brokers—strategically manage the boundaries of scientific authority in ethically complex policy environments. Advisors engage in boundary work by defining the limits of their guidance, maintaining neutrality (in an ideal sense) while reinforcing their credibility as technical experts. Influencers push these boundaries further, framing ethical concerns as scientifically grounded to justify their advocacy and expand the reach of their expertise. Gatekeepers protect the integrity of ethical standards by drawing firm lines around acceptable practices, often invoking institutional authority to legitimize their oversight. Facilitators and brokers, meanwhile, blur and bridge boundaries by creating inclusive spaces for dialogue and translating between technical and policy domains. Across these roles, boundary work enables STEM professionals to navigate tensions between expertise and advocacy, neutrality and engagement, and science and values—ultimately shaping how their authority is perceived and sustained in AI governance.

On the other hand, Abbott's (1988) theory of the system of professions offers a more structural lens through which to understand how STEM professionals in this study assert and negotiate their authority in the evolving domain of AI governance. Each role reflects a unique form of jurisdictional claim over ethical and technical expertise. Advisors and gatekeepers reinforce professional control by guiding or enforcing ethical standards, often drawing on institutional legitimacy to defend their domain. Influencers seek to expand professional boundaries by advocating for ethical priorities that may challenge or reshape existing policy agendas. Facilitators and brokers, meanwhile, function at the intersections of professional domains, leveraging their positions to mediate between disconnected groups and translate across disciplinary boundaries. These roles illustrate how STEM professionals not only respond to institutional gaps but also actively compete for and construct new areas of influence, demonstrating the *dynamic and contested* nature of professional authority in ethically charged policy spaces.

Conclusion

This study introduces a typology of roles for AI professionals, dividing them into two main categories. Two groups of roles identified in this study—advisor, influencer, and gatekeeper in the first group, and facilitator and broker in the second—highlight distinct yet complementary contributions that STEM professionals make to ethical AI governance. In the first group, professionals leverage their interdisciplinary expertise to guide and educate stakeholders on both technical and ethical dimensions of AI. The second group focuses on strategic social positions within policy organizations and networks. Both roles are essential in keeping AI governance responsive to the rapid pace of technological change.

However, we are also aware that this study has several limitations. Firstly, while this study provides insights into the broad categories of roles, it does not go deeply into how personal characteristics such as gender, race, and seniority affect the way these professionals engage with these roles in AI policy and ethical governance. These dimensions are crucial because they often shape not only the opportunities available to STEM professionals but also the perspectives they bring to the table (e.g. Faulkner 2009; Elliott & Smith, 2004). Also, STEM fields are highly specialized, with specific subfields such as computer science, bioengineering, and chemical engineering likely leading to varied approaches in policy engagement and governance. Understanding these subtleties would require further investigation into how specific STEM backgrounds shape the scope and nature of policymaking roles. Lastly, the qualitative, interview-based nature of this study provides a "snapshot" view of the roles STEM professionals assume in policymaking, which offers valuable but momentary insights into the participants' responsibilities and influence. A more dynamic approach to data collection—such as diary studies (Ohly et al., 2010)—could offer a richer understanding of the roles taken by the practitioners. Ultimately, to further validate the typology of roles assumed by STEM professionals in AI policy, future research could develop a quantitative survey based on the qualitative findings of this study and administer it to diverse groups of STEM professionals engaged in AI policy.

Overall, while this study offers a detailed account of how STEM professionals perceive and enact their roles in AI policy, it does not directly evaluate the extent to which these roles influence concrete policy outcomes. The findings are grounded in participants' self-reported experiences and intentions, which provide valuable insights into how they conceptualize their contributions. However, the *actual* impact of these roles on shaping policy decisions remains an unsolved question. Future research could build on this work by tracing the pathways of influence, such as examining policy documents, institutional changes, or stakeholder responses, to assess how expert interventions and their framings about ethics translate into policy effects. Addressing this limitation calls for future studies that evaluate not only how professionals engage with policy, but also how their efforts are received, institutionalized, or contested within broader governance systems.

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