

Creatively interpreting policy to move science forward: Implementing participatory technology assessment at NASA

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Abstract

Entrepreneurial strategies and tactics are often subtle and indiscrete, adding to the mystery of how one goes about being an entrepreneur, particularly within bureaucratic agencies that are often set up to constrain such behaviors. The authors use a case study of the U.S. National Aeronautics and Space Administration (NASA)'s public engagement practices to examine how entrepreneurs shift policy interpretations with administrative agencies. Findings describe three entrepreneurial strategies and tactics: (1) using one-on-one or small group meetings to connect to different audiences across organizations; (2) tying new policy interpretations to existing ones, so changes seem less radical; and, (3) positioning oneself in the middle of the action to control both narrative and progress. Conclusions discuss both practical mechanisms for shifting away from the status quo, and the theoretical contributions to a growing body of literature on strategic and tactical approaches of bureaucratic entrepreneurs in democratic systems.

KEYWORDS

entrepreneurship, NASA, public engagement

INTRODUCTION

Entrepreneurship has been a value construct in public policy and administration since early reformers embraced the need for radical, innovative change in the functions and forms of government. Contemporarily, the focus on entrepreneurship reemerged as part of the New Public Management movement as a mechanism or a catalyst, depending on one's perspective, to “reinvent government” (Osborne & Gaebler, 1993). In turn, this fueled efforts by both graduate programs and local governments to train and encourage entrepreneurship among bureaucrats and citizens (e.g., Korosec & Berman, 2006; Wiley & Berry, 2015). Of course, scholars continue to question how to reconcile an entrepreneurial role for administrators, requiring a degree of autonomy, risk-taking behavior, and a personal vision for the future, with that of democracy, relying on accountability, citizen participation, collaboration, transparency, and stewardship (e.g., Bellone & Goerl, 1992). Recontextualizing this debate, Bernier and Hafsi (2007) argue that “public entrepreneurs do not create new artifacts, nor do they design grandiose projects, but they slowly reinvent their organizations, and in so doing, transform the systems that control government effectiveness and efficiency” (p. 488), and Bernier (2014) furthers this by contending that public entrepreneurship should become a larger focus of scholarship as it often drives strategic decisions, policy interpretations, and organizational cultures that impact the efficacy of governance. To this end, entrepreneurship is less about grand reforms, than it is about modernizing status quos within administrative agencies to match a changing political, social and economic landscape.

Of course, this means that entrepreneurial strategies and tactics are often subtle and indiscrete, adding to the mystery of how one goes about being an entrepreneur. Despite the broader debate over entrepreneurship in the public sector, scholarship on the strategies and tactics used by public entrepreneurs to affect policymaking, implementation, or administrative processes is still a maturing area. Specifically, there are lingering questions concerning how exactly one goes about pursuing goals of change and reform within administrative agencies that are naturally risk-averse and inclined to maintain the status quo. In other words, how does the average bureaucrat, often seen as just a cog in the machine, alter the status quo within their organizations? Scholarship on public entrepreneurship as well as from the multiple streams framework (MSF) sheds light on the role of administrators as entrepreneurs who can use ambiguity to their advantage and pursue re-interpretations of policy as a means to change how their organizations approach problems (e.g., Fowler, 2019). To contribute to this discourse, we use a case study of the U.S. National Aeronautics and Space Administration (NASA)'s public engagement practices, specifically, a shift from conventional one-way dissemination of mission objectives and citizen science projects that only involve the public in already-decided programs to incorporating participatory technology assessment (pTA)—a deliberative form of public participation—in order to broaden how the space agency interacts with citizens in program design and decision-making.

Using qualitative interviews, we examine strategies and tactics used by policy entrepreneurs to build support for an alternative interpretation of “Partnerships and Participatory Engagement” in NASA's Asteroid Initiative and to leverage that support to push for a change in the public engagement status quo. While the question of whether, or how, pTA actually impacted the agency's decision-making on the Asteroid Initiative's program design is important, our goal here is to elucidate how entrepreneurs in NASA were able to shift thinking around public engagement that led to the adoption and implementation of pTA. Findings describe three entrepreneurial strategies and tactics used during administrative and implementation processes: (1) using one-on-one or small group meetings to frame arguments in ways that connect to different audiences across organizations; (2) tying new policy interpretations to existing ones, so changes are not presented as radical; and, (3) positioning oneself in the middle of the action to control both the narrative and the progress. At a practical-level, this case study illustrates

mechanisms that administrators can use to shift away from the “way things have always been done” to meet the challenges of an evolving world. Theoretically, it contributes to a growing body of literature that seeks to separate bureaucratic entrepreneurs from policy entrepreneurs by examining their strategies, tactics, and role in democratic systems (e.g., Arnold, 2015).

ENTREPRENEURSHIP IN POLICY & ADMINISTRATIVE PROCESSES

Entrepreneurs are often cast as someone “who possesses specific qualities (some of them innate) that enable that individual to be successful in convincing the public and their colleagues of the value of a new instrument method or idea” (Mack et al., 2008, p. 234). Although definitions vary, entrepreneurship is often grounded in the idea that “unleash[ing] the creative and innovative capacities of public managers” (Peters & Savoie, 1996, p. 283) leads to new ideas that reduce red-tape, promote efficiency and effectiveness, empower employees to take responsibility for their decisions, and lead to higher satisfaction of public services from target populations (Moon, 1999). To this end, Mintrom (1997, 2019a, 2019b) argues for entrepreneurs as a distinct and identifiable class of policy actors that serve a unique function in policy and administrative processes. Of course, Larry Terry (1990, 1993, 2003) was one of the most ardent critics of administrative entrepreneurship, instead arguing that public administrators played a role as conservator and should protect that which cannot be easily regained if lost. However, Petridou and Mintrom (2021) contend that scholarship on policy entrepreneurs needs to “specifying the strategies policy entrepreneurs deploy” and “identify when policy entrepreneurs prompt widescale change” (p. 943). While the strategies and tactics used to convince one's colleagues have been examined far less than those used to convince the public or policymakers, this scholarship often cross-pollinates so that insights from policymaking processes have been used to understand bureaucratic entrepreneurship.

Klein et al. (2010) argues that entrepreneurship is characterized by identifying opportunities, judgmental decision making (e.g., balancing of risks and uncertainty), and pursuing innovative ideas. Additionally, Klein et al. (2010) contend that these characteristics operate at four levels by (1) alternating the rules of the game; (2) creating new public organizations; (3) creatively managing public resources; or (4) managing spillovers of private actions into the public domain. In contrast, Moon (1999) contends entrepreneurship often focuses on either products (i.e., quality of final outcome), processes (i.e., administrative mechanisms), or behaviors (i.e., propensity for risk-taking). In other places, entrepreneurship is bound together conceptually with innovation (e.g., Mack et al., 2008) or as a class of managerial qualities such a leadership (e.g., Vigoda-Gadot et al., 2008). For instance, Osborne and Brown (2005) define innovation as “introduction of new elements into a public service—in the form of new knowledge, a new organization, and/or new management or processual skills, which represents discontinuity with the past” (p. 4).

Additionally, scholars of technological change and innovation systems examine patterns of how organizational complexities shape the evolution and adoption of technology. For instance, revolutionary or transformational patterns often result from chaos and uncertainty where ambiguous conditions overtake previously understood problem-solving models, while more moderate change come about through incremental adjustments to existing technology and networks (e.g., Pittaway et al., 2004). To this end, entrepreneurs often play important roles in dictating the pattern of change by facilitating how deviations from existing problem-solving model are internalized and understood by organizations. Kash and Rycroft (2000, 2002) frame entrepreneurial strategies in this context around understanding, communicating, and impacting the broad context of organizations, intelligence gathering, coordinating across organizational units, and filling gaps that emerge. Furthermore, they also suggest managers

should avoid trying to control the process, ask the right questions to understand the forcing shaping the innovative trajectory, consider diverse perspectives and allow ideas to mature, and to create a roadmap to understand progress (Rycroft & Kash, 1999). Notably, though, innovation is often conceptually applied at an organizational-level, as opposed to entrepreneurship which is often thought about at an individual-level (de Vries et al., 2016). This often means that innovations that come out of large organizations are ultimately driven by the individual efforts of entrepreneurs operating to manage the larger organizational processes of decision-making.

Theoretically, multiple streams framework (MSF) provides additional depth to understanding the role and functions of entrepreneurial behaviors in policy and administrative processes, particularly as it applies to establishing acceptability of ideas across policy networks and placing entrepreneurs into a broader framework of democratic governance. From this perspective, decisions are made within organized anarchies where ambiguity (i.e., different ways of thinking about the same phenomenon) is precipitated by problematic preferences (i.e., uncertainty concerning what choices best serve one's interest), unclear technologies (i.e., lack of clarity on rules, processes, or practices for achieving one's goals), and fluid participation (i.e., people shift from one decision process to the next with little order). Entrepreneurs are able to use this ambiguity to their advantage by manipulating how decision-makers interpret events and understand how problems, solutions, and the political landscape come together (Herweg et al., 2018). Furthermore, entrepreneurs operating in policy communities (e.g., networks of public servants, academic, and other experts) are also essential to introducing and testing the viability of new ideas in terms of its technical feasibility, value acceptability, public acquiescence, and financial viability. As feedback from policy communities becomes available on these issues, ideas are adjusted to better meet criteria. This "softening up" process, though, plays out differently based on community organization so that large, loosing integrated communities that are more competitive operate differently than smaller, integrated, and/or cooperative communities (Herweg et al., 2018; Kingdon, 1995).

While MSF has been criticized for focusing too much on policymaking, recent developments have expanded its theoretical constructs to policy implementation and administrative processes. For instance, Zahariadis and Exadaktylos (2016) find that entrepreneurial strategies and political manipulation were key to disrupting the implementation of higher education reforms in Greece, and Fowler (2019) uses the MSF structure to analyze the conditions that cause shifts in how federal environmental policies are implemented by state governments. The key difference here is that once policy moves into the implementation and administrative phases, decisions change from a centralized approach set in legislative bodies seeking consensus or compromise to a decentralized approach where a myriad of actors across organizations act on their own interpretation of a policy. Entrepreneurs are then trying to convince this disjointed group to interpret policies in a way that leads to a set of implementation behaviors aligning with their goals. The cumulative norms of those behaviors, then, become the way things are done, establishing a *de facto* status quo. By extension, there is an inherent wont by organizations to uphold these status quos in order to reduce risks and create certainty about how policies will be administered (Fowler, 2019, 2022).

Bureaucratic entrepreneurs

While extant scholarship distinguishes bureaucratic entrepreneurs from policy entrepreneurs (e.g., Arnold, 2021; Goyal et al., 2020), the mass of scholarship on strategies (e.g., Meijerink & Huitema, 2010) and tactics (e.g., Nash & Steurer, 2021; Zahariadis, 2005) is derived from work on policy entrepreneurs. Nevertheless, Arnold (2021) argues that bureaucratic entrepreneurs operating in policy implementation or administrative processes differ from their counterparts focused on policymak-

ing along four dimensions: motivation, constancy, network participation, and network composition. Specifically, bureaucratic entrepreneurs tend to: be motivated by the status quo and will innovate only when the gains associated with innovation are greater than the costs or risks; be engaged in the process of entrepreneurship on a constant basis (as opposed to a flurry of activity focused around a policy window); build networks consisting of other bureaucrats in key positions to affect change; and, face challenges in balancing their relationship with external actors who often have different goals in mind. Furthermore, Cohen and Aviram (2021) argue that these type of entrepreneurs focus chiefly on addressing acute crises within their agencies, as opposed to broad scale policy change, and rely on their personal discretion and professional knowledge to problem solve within that context.

Unfortunately, there is a dearth of scholarship examining entrepreneurs operating in an administrative environment and seeking to alter how policies are interpreted (Arnold, 2015; Aviv et al., 2021). Zahariadis and Exadaktylos (2016) is one of the few examples, with the authors zeroing in on issue-linkage and framing, side payments (i.e., promises of distributing future benefits on supporters), and institutional rule manipulation as key strategies. Drawing from a broad literature review of MSF scholarship on policy entrepreneurs, Mintrom and Norman (2009) offers additional insights though. Specifically, they identify three elements of entrepreneurship: defining problems (i.e., manipulating how individual's perceive problems to exist in the context of their own self-interest), building teams, and leading by example (or reducing risk perceptions by illustrating how something can be done). In general, this scholarship indicates that strategies tend to focus on building support coalitions and creating a shift in how organizations collectively view what policies mean. Specifically, entrepreneurs are often more successful when they can link issues together and frame arguments in a way that attract supporters and justify policy interventions, as well as use institutional rules to narrow decision-making in a way that structures what information is available and constrains participation.

Three common elements emerge from both the literature on policy entrepreneurial strategies and that from bureaucratic entrepreneurs. First, entrepreneurs create buy-in across a broad group of stakeholders whose support may affect success (e.g., Mintrom & Norman, 2009). Within bureaucracies, this may initially focus on street-level bureaucrats or mid-level managers who have the capacity to make decisions about how policies will be implemented, but can also include political actors or policy networks who serve as stakeholders of the broader organization (e.g., Fowler, 2019). In terms of the latter, external stakeholders can play a spoiler role if their interests are not taken into consideration. At a tactical-level, entrepreneurs frame and re-frame their messages to different groups in order to emphasize elements that play to specific interests. This may include components of issue linkages, affect priming, symbolism, or presenting a good narrative with the goal to get the individual or small groups to buy into the policy interpretation being presented. Additionally, entrepreneurs may make promises of how future benefits or value is distributed across groups (i.e., side payments) (e.g., Zahariadis & Exadaktylos, 2016). This process also serves to “soften up” any policy proposals as entrepreneurs gain feedback and adapt their message to new groups (Herweg et al., 2018).

Second, entrepreneurs establish logical pathways to justify policy interpretations. In most cases, entrepreneurs use existing policy interpretations to ground their arguments, so innovative policy interpretations appear as an extension of existing status quos, as opposed to radical new ideas (e.g., Fowler, 2021). In order to create buy-in from disparate groups across organizations, entrepreneurs need to convince them that their policy interpretation is logical, rational, and satisfies the technical merits valued by the organization (e.g., Zohnhofer & HuB, 2016). On one hand, risk-averse bureaucrats are often hesitant to move away from established ways of doing things that are predictable; on the other hand, existing policy interpretations are often “blessed” or approved by external political stakeholders. Thus, presenting new policy interpretations as incremental changes designed to address a changing problem preempts both internal and external resistance. Entrepreneurs may also include

elements of issue linkage where one set of actions is presented as a mechanism for implementing multiple policies or advanced multiple organizational goals. Taken together, this creates a compelling narrative where adjustments to the way things are done can be used to meet multiple objectives that are currently being unaddressed.

Finally, entrepreneurs take advantage of institutional contexts, so that they control both the narrative and the action as it advances through administrative and implementation processes (e.g., Mintrom & Norman, 2009). This may include salami slicing tactics to manipulate sequential decision-making as well as efforts to control who participates in decisions (e.g., Zahariadis, 2003). In either case, a command of organizational rules or administrative processes can be used to construct barriers for other entrepreneurs seeking to derail the initiative, as well as make it easier for entrepreneurs to guide the process at each step. In sum, the goal of these efforts is to create enough acceptance of a policy interpretation so that it cannot be cast as an illegitimate exercise of policy authority or abandoned by the organization on technical merits, as well as to prime the organizational members to follow along if/when they need to act. Given this, we expect that entrepreneurs seeking to change the status quo within administrative agencies are likely to: (1) use a piecemeal approach to build a coalition of supporters across the organization by catering unique messages; (2) tie new policy interpretations closely to existing policies; and, (3) place themselves in the action in order to control the narrative and process. By doing so, entrepreneurs make it more difficult to dislodge their policy interpretation from the organization and/or reduce the likelihood that other entrepreneurs hijack their initiative.

METHODOLOGY

We use a case study approach to examine the process of implementing NASA's Asteroid Initiative with specific focus on the pTA component. We draw on two sources of data: public documents from NASA and the Expert and Citizen Assessment of Science and Technology (ECAST) network; and semi-structured interviews with NASA personnel and ECAST members who worked on the pTA project. In the text, interviewees are identified by their organizational affiliation and a numerical identifier. Public documents, mostly from NASA (e.g., press releases, request for information), are used to establish background details. Semi-structured interviews comprise the bulk of the data collected. Subject identification and recruitment for this research was facilitated by network contacts with ECAST which provided access to and introductions with a finite list of ECAST members and NASA personnel involved with the pTA project. A snowball sampling technique was used at the end of each interview to ensure that the list of participants was not self-limiting, especially with NASA personnel. Twelve (12) semi-structured interviews were conducted between June and October of 2019; seven (7) with ECAST members, five (5) with NASA personnel.

Of the five NASA personnel interviewed, four worked directly on the pTA project in close coordination with the ECAST team, and one was an agency manager with a supervisory role in the Asteroid Initiative. Other NASA personnel with supervisory roles in the Asteroid Initiative that we were referred to did not answer our requests for interviews. In the process of snowball sampling, all five NASA personnel referred to each other as people to contact within the agency. While limited to five NASA interviewees, our main question concerned the strategies and tactics used during administrative and implementation processes, so we believe that hearing from the only four personnel who worked on the pTA project grants ample insight. Interviews were conducted remotely on Zoom and Google teleconferencing platforms, and ranged from 40 to 70 min in length for a total of 750 min (or over 12h) of interview data. Participants were asked questions exploring topics concerning the purpose of the Asteroid Initiative, its components, and which NASA offices and directorates were

involved. Participants were also asked to reflect on NASA's interest in "Partnerships and Participatory Engagement" and pTA in relation to the agency's strategy and history of public engagement and participation in decision-making processes.

Lastly, participants, especially NASA personnel, were asked to identify the sources of resistance and challenges to public participation in NASA decision-making processes, and how the relationship between NASA personnel and ECAST members facilitated designing and implementing the pTA exercises. We conducted data analyses on two levels. First, documents and interview transcripts were imported into NVivo 12 Pro, a qualitative data analysis software, where they were coded for themes among answers to interview questions (Campbell et al., 2013; Fereday & Muir-Cochrane, 2006; Maher et al., 2018). Second, data were further reduced and organized into analytic memos where themes and concepts across interviews were brought together to build analytic narratives. Following a modified grounded theory approach, themes and concepts emerging from the data were used to refine interview questions to better target explanatory details, and to begin to build a theoretical model that generalizes those details (Charmaz, 1990, 2017). At the same time, theories from policy studies and public administration were used to inform the questions initially asked, the analysis of data, and coding—hence “modified” and not a purely grounded theory approach.

PARTICIPATORY SCIENCE & NASA'S ASTEROID INITIATIVE

NASA announced its Asteroid Initiative in April of 2013. The Asteroid Initiative had two components—the Asteroid Grand Challenge (AGC) and the Asteroid Redirect Mission (ARM). The goal of the AGC was to fulfill a Congressional mandate to detect all hazardous asteroids in near-Earth space and to develop a planetary defense strategy concerning near-Earth asteroids and impacts. The ARM stemmed from an Obama White House directive to make progress on the longstanding goal of a human mission to Mars. The ARM intended to do this by developing an asteroid capturing and redirecting system as a technological proving ground for a human mission to Mars. In June of 2013, NASA released a request for information (RFI) for the Asteroid Initiative through the AGC. As a formal federal government “grand challenge,” the AGC RFI was touted as “the first opportunity for industry and other potential partners, including private individuals, to offer ideas on planning for NASA's mission to redirect an asteroid for exploration by astronauts and the agency's asteroid grand challenge” (NASA, 2013b).

The AGC RFI called for input on “Partnerships and Participatory Engagement,” specifically for “innovative methods such as crowd sourcing, prizes and challenges, citizen science, and public-private partnerships to increase the resources for tackling the planetary defense problem and to broaden participation” (NASA, 2013a). This was happened in parallel with the Obama administration's Open Government Initiative (OGI) which promoted principles of transparency, participation, and collaboration throughout executive agencies (Holdren et al., 2009). ARM, according to NASA-3, received “the lion's share of the money in the Asteroid Initiative” and NASA “didn't have the money to effectively accomplish the legislative mandate” from Congress to identify hazardous asteroids. Facing this implementation problem, NASA created the AGC as an effort “to use novel techniques, whether citizen science or public-private partnership or Prizes and Challenges as a way of accelerating work” (NASA-3). Additionally, it was a way to “test a hypothesis of how the public and other nontraditional partners could be involved in achieving things that NASA can't do alone” (NASA 2). While the RFI was reminiscent of previous NASA RFIs when it came to addressing technical science and engineering challenges, the “Partnerships and Participatory Engagement” component was unique to the AGC. NASA-3 shared that this was: “just not inherent in a mission directorate's plan or designed to have that kind of thinking. So it was, from my perspective, a pretty unique question.”

NASA-2 shared that this sixth item in the RFI offered “the ability for people to propose to us unique approaches to public engagement ... we were primarily thinking it'd be Prizes and citizen science.” As originally drafted, the sixth item of the AGC RFI was not a call for deliberative forms of public participation into the program design of the Asteroid Initiative, but for a more conventional approach to science and technology public engagement, such as citizen science. Established in 2010, ECAST is a network of academic research, policy analysis, citizen science, and informal science education institutions distributed across the United States that works towards greater public involvement in issues at the intersection of science, technology, and society (Kaplan et al., 2021; Sclove, 2010). NASA-5, familiar with ECAST's work, informed them that there was an open RFI for the AGC with an item for “Partnerships and Participatory Engagement.” In response, ECAST submitted pTA exercises as an innovative method of participatory engagement for Asteroid Initiative program design and decision-making. By May of 2014, NASA selected ECAST's pTA proposal and entered into a cooperative agreement to design and implement the pTA exercises.

Between May and September of 2014, representatives from NASA and ECAST met to design the content and plan the implementation of pTA as the Citizen's Forum on NASA's Asteroid Initiative. In November 2014, daylong forums took place in two cities—Phoenix and Boston. The four topics for deliberation were asteroid detection, asteroid mitigation, deciding between two engineering options for the ARM, and three scenarios for human space flights for Mars exploration. During the forums, participants read background materials to inform them on the four topics, deliberated the topics, engaged with experts via questions and answers, and, finally, voted on a set of questions jointly prepared by NASA and ECAST. An interim report consisting of the results from the ARM session was delivered to NASA managers in December 2014, prior to a downselect decision about which of two options the agency should pursue for the ARM. On March 19, 2015, the ECAST team made a top-level briefing at NASA headquarters. A summary and full report of the results consisting of additional assessments and evaluation were publicly released in August 2015.

THE STATUS QUO POLITICS OF PUBLIC ENGAGEMENT AT NASA

Both NASA-1 and NASA-5 articulated the idea that NASA has historically had a predilection to public engagement in the form of one-way information dissemination. NASA-1 stated that “public engagement for NASA has historically been largely dissemination of information” citing the Apollo missions from the 1960s, where the public engagement strategy was “build a big rocket and send it into space and tell everybody how great America is.” When asked on what the current strategy is, they shared that “we haven't progressed in 50 years.” NASA-5 shared similar sentiments and added that they think that it stems from a “propagandistic” commitment by a “powerful minority” in the agency to a narrow view of NASA's founding legislation, the Space Act of 1958, which directed NASA to share its mission with the public. Scholarly examinations of NASA's history corroborate this kind of reading, highlights the agency's consistent approach to public engagement as a tool for garnering public support to create political capital in Congress and the White House (Lambright, 2010).

NASA-1 and NASA-5 noted that even the limited history of engaging the public for the purposes of informing the agency's missions and programs were still modeled after this “get the word out” approach and had goals of collecting public opinion to better NASA's public image. According to NASA-1, NASA's Office of Communications (OCOMM) plays an outsized role in reinforcing this “get the word out” approach to public engagement through traditional media. NASA-1 and NASA-5 independently referred to the 1986 Paine report (i.e., *Pioneering the Space Frontier: The Report of the National Commission on Space*) where town hall meetings were held to hear civilian perspectives

on the future of space exploration, as well as a similar sets of meetings in the early 1990s. In terms of the latter, NASA-5 shared that one of their supervisors in the agency involved in those town hall meetings “actually bragged ‘yeah, we went to all these things; we never learned one new thing.’” After speaking with NASA personnel who had been involved in both of these town hall meeting activities in the 1980s and 1990s, NASA-1 shared that they were all “a little skeptical about the real extent of how valuable those were ... [and] it’s kind of hard to tell the extent to which anybody was going to take those [public] comments seriously or if these were more to validate what was already going on.”

NASA entrepreneurs shared that like most federal agencies, NASA is sensitive to the political processes that impact its budget and support, and “when NASA says stakeholders, they are ... talking about the Presidential administration and the Congress—political stakeholders.” Given this, NASA is “apprehensive about disrupting whatever balance and agreements the leadership thinks it has with the White House and the Congress.” For example, when agency leadership is deciding on projects, those projects are presented to the public and its political stakeholders. NASA-1 described an instance when a project appeared to be something different from what the political stakeholders had sanctioned. They characterized the leadership’s attitude as, “We couldn’t possibly put that out there because we already knew what we were going to do, because it was already politically blessed.” Agency leadership is resistant to some ideas because they are sensitive to the need to stay in alignment with the projects and directions that have been “politically blessed” by Congress and the White House. In the eyes of the NASA entrepreneur team, ECAST’s pTA approach was a marked departure from the agency’s usual public engagement practices, specifically given that no one had ever seen anything like the ECAST method of public engagement at the agency before.

NASA-1 highlighted how the ECAST approach offered NASA “such a different view of the public role than we had typically seen in the agency.” Moreover, according to NASA-1, “ECAST’s methodology [of public engagement] was the first I’m aware of that NASA has ever used.” NASA-4 shared that when it comes to program planning, “to show a public audience something in a very preliminary stage and get their thoughts and reactions, to ask ‘what do you think of this idea?’ It’s certainly not the way the agency usually does those things.” Given how much of a departure it was from NASA’s historical use of public engagement, pTA could potentially disrupt the “politically blessed” agreements. NASA-1 pointed to concerns of “what if the public comes in and says we think we should do something 180 degrees different than what we’ve already got an agreement to do?” Most of the “apprehension” about what may disrupt “politically blessed” agreements, “really comes from our comms [OCOMM] and legislative folks [Office of Legislative and Intergovernmental Affairs] more so than our technical senior leadership.” NASA-2 corroborated this and added that public participation concerns are “more of a communications office [OCOMM] fear usually, a hesitance maybe to talk about planning before a decision has been made.”

SHIFTING THE STATUS QUO

Key to entrepreneurs within NASA was the ability to garner support from a broad range of colleagues, supervisors, and managers across different directorates, offices, and programs. Because of their knowledge of NASA’s cultural and political dynamics, they knew they had to work strategically so that NASA managers would support pTA through the design and implementation phases. From interviews with NASA personnel, it appears that ECAST’s pTA submission was not necessarily what NASA personnel initially had in mind for “Partnerships and Participatory Engagement.” According to NASA-2 and NASA-3, citizen science projects for identifying and tracking asteroids were the expected kinds of submissions. At the same time, NASA-3 shared that they “hadn’t seen another type

of engagement like ECAST was proposing ... [and it] could be valuable ... [to] show that, yes, this is actually a really effective tool.” Even though the initial idea for the RFI’s sixth item was citizen science projects, NASA-2 and NASA-3 shared the broader approach to the subject of public engagement that “there’s no clear decisions in space, and they’re not always just technical decisions.”

NASA-2 read ECAST’s pTA submission as a way of “filling the OTA gap” that the now-defunct Congressional Office of Technology Assessment once filled of advising Congress on the sociopolitical impacts of science and technology. This gap would be filled, however, through incorporating a deliberative method of public participation in agency program design. NASA-2 and NASA-3 worked to transform an RFI meant to accomplish a Congressional mandate with limited resources into a vehicle for greater public participation in the Asteroid Initiative’s program design and decision-making processes when they saw ECAST’s pTA submission. Namely, as a way of “filling the OTA gap” of considering the public’s perspectives on science and technology programs, and as a way of building value in a different public engagement approach that could prove to be a “really effective tool” in agency program design. Notably, however, this initial decision was made with mid-level discretion. NASA-5 shared that the pTA project could still have been shut down by agency leadership in the design or implementation phases if the entrepreneurs had not organized themselves to address the organizational politics, culture, and administrative challenges facing an innovative form of public participation that would pit itself against the agency’s status quo politics surrounding public engagement.

Specifically, NASA entrepreneurs knew they had to have a clear presentation of the benefits of pTA-style public participation to agency leadership before they could begin to design and implement. For instance, NASA-5 recounted that early on, once ECAST’s pTA submission had been selected and the policy entrepreneur team convened to strategize among themselves. NASA-5 shared:

Internally to the NASA team, to myself and to [NASA-1] and [NASA-3] prior to the ECAST members onboarding, [NASA-2] said at one point that there was some concern that we could really freak managers out because there’s not a clear-cut story on this. We could get told by NASA management that we have to shut this down. We need to make sure that this starts going smoothly.

The NASA entrepreneur team knew to anticipate concerns from agency management and leadership regarding maintaining a good relationship with their political stakeholders and were able to present pTA in a way that navigated these apprehensions.

NASA-1 explained the strategic approach they took to agency leadership:

There were meetings that we set up with various senior leaders within the agency to gauge their sense of approval and how they felt about this ... We did the meetings individually. That was one thing that we were very deliberate about was to do one-on-one meetings versus group meetings. We didn’t want it to become group opinions against, or we didn’t want anyone to feel like they couldn’t speak up and share their opinion if it was different than what we expect.

NASA-2 described this strategy as a “roadshow” approach:

You lay out why you think it’s beneficial but hav[e] a kind of a super drafty form so people that might be opponents to it inside an agency feel like they can inform the idea a little bit. You go last to the people that you think are going to be the most opposed to it.

By that point, you've already talked to and have a lot of people [who] are supportive, so it's harder for them to say no.

By presenting the project idea as a rough sketch open to changes, it afforded flexibility in terms of how to approach senior members of NASA. Ultimately, this amassed approval and support from individual members of senior leadership that facilitated designing and implementing pTA.

After convincing agency managers that pTA was something worth considering in the Asteroid Initiative's program design decision-making, the NASA entrepreneur team opted to enter into a cooperative agreement with ECAST instead of a conventional contract to do the design and implementation work. Compared to a conventional federal government contract, a cooperative agreement has an "additional criterion that the agency expects to have substantial involvement with the recipient in carrying out the activities contemplated in the agreement" (Ziens, 2010). Importantly, entering into a cooperative agreement allowed NASA entrepreneurs to support designing and implementing pTA method in ways ECAST may not have been able to do on its own. NASA personnel shared that this was an intentional choice that would facilitate their ability to foster support for pTA and help navigate the political and administrative challenges it may face during the design and implementation processes. According to NASA-1:

We deliberately chose to do this by way of a cooperative agreement ... it wouldn't have carried weight as much if it had been exclusively left to ECAST to do. I think that's a really important point, which is that it needed to be collaborative to be bought into and trusted by NASA leadership.

It also created the impression that the NASA entrepreneurs were taking "personal accountability" for the project. Additionally, NASA-1 shared that a cooperative agreement "gave us [NASA entrepreneurs] the ability to control it. I don't mean that in a negative sense. I mean, arguably, we're more in touch with what's politically permissible within the agency."

Opting for a cooperative agreement was not the only use of the entrepreneurs' administrative knowledge and expertise. They also applied it to grappling with the administrative rules regarding public participation in federal government agencies. According to NASA-2, "there's always the standard questions around, 'well, how does FACA [Federal Advisory Committee ACT] and the PRA [Paperwork Reduction Act] apply to this? You're getting public input on something, don't you have to go through a lengthy process with OMB [Office of Management and Budget]?' " NASA-2 shared that when it comes to these administrative rules, "there's a lot of myths about what you can and can't do," leading federal agencies and personnel to be "afraid to engage with the public because they don't know how to do it within the rules." The complexity and legal force of these administrative rules often create a sense that these rules are hurdles to public participation. NASA-2 shared that for federal government personnel designing and implementing public participation it means that "often times you're paving the way if the agency's just not thought that it was worth it to try to figure out how to do it in the past."

In this light, the team of NASA entrepreneurs had to pave a new path through these rules to address the administrative concerns NASA managers could have about pTA. Two NASA entrepreneurs mainly did this work: NASA-2 by strategically quelling concerns with OMB memos, and NASA-3 by capitalizing on their relationship with NASA's Office of General Counsel (OGC). For instance, NASA-2 would often refer to M-10-11, "Guidance on the Use of Challenges and Prizes to Promote Open Government," part of the Obama administration's OGI, to quell legal concerns regarding administrative rules and to advocate the benefits of pTA. M-10-11 addressed the "common questions around legal hurdles" to innovations concerning public participation by using prizes and challenges to

promote public participation. Moreover, M-10-11 was “basically the permission to the agencies to say, ‘not only are we supportive of this, but here’s the reasons why these things are useful.’” Even with this broader political and administrative support, NASA-3 shared that there were still technical aspects of the administrative rules surrounding pTA that had to be negotiated with NASA’s OGC, and OGC personnel “are paid and in place and they are designed to protect the agency. And they take that job very seriously. And they can be very deadset in their ways.”

According to NASA-3, administrative rules had already stopped other forms of public engagement from being a part of the Asteroid Initiative: “There is always the potential threat or challenge of FACA ... even Paperwork Reduction [Act]. It prevented us from having people volunteer their time to take telescopes into their backyard and look for asteroids. That was prohibited.” If something as seemingly innocuous as the public using telescopes in their backyards to look for asteroids was prohibited, using pTA to gather the public’s thoughts on the Asteroid Initiative would also likely face administrative challenges. The NASA team of entrepreneurs “were fortunate to have some folks in that office [OGC] that really wanted to figure out how to do things better” in terms of clearing ECAST’s innovative pTA method of public participation. NASA-3 found that the OGC staff were “willing to explore and understand what you’re trying to accomplish and have conversations with you to figure out how to accomplish that so that you actually become a client of theirs rather than them holding the rules and saying, ‘“you can’t do this, that, or the other.”’ Having this kind of relationship with the OGC, according to NASA-3, was central to building a path through the administrative rules that govern how federal agencies can engage with the public in government program design and decision-making.

Furthermore, the NASA entrepreneurs’ knowledge of and experience with the agency’s organizational politics and culture equipped them to navigate how the OCOMM controlled messaging in order to avoid speculation about ideas that are not “politically blessed.” NASA-1 shared that they made it a point to “not push too hard with OCOMM.” NASA-1 detailed that: “As much as we wanted to tout this and share it and announce it broadly because it was so new and different, it was sort of a soft, quiet announcement ... I think they were both very quiet so not to get the comms people spun up.” Getting the OCOMM too “spun up” at the beginning could have possibly meant getting the pTA project flagged as something that would disrupt the “politically blessed” agreements the agency has with Congress and the White House. Thus, the NASA entrepreneurs chose to both announce the Citizen’s Forum pTA exercises and share its results through a web feature to avoid as much scrutiny as possible, as OCOMM had traditionally reserved press releases for the projects that were “politically blessed” and that they wanted to draw attention to.

DISCUSSION

This case study highlights the pathway that pTA took through NASA. Initially, NASA administrators did not see pTA as fitting their policy objectives, but a few entrepreneurs saw the potential in the ECAST proposal to shift the way the space agency engaged with the public. Of course, this required a shift in thinking about the Asteroid Initiative’s Grand Challenge and the role citizens played in scientific decision-making. Knowing it was an uphill battle, the entrepreneurs first took the proposal on a “roadshow” to different audiences, curtailing their message to build support and sell the idea that this proposal fit the agency’s goals and specific policies that they were responsible for implementing. Notably, the entrepreneurs focused on one-on-one or small group meetings, as opposed to a wholesale approach. This allowed them to speak to individual interests that diverged across the organization,

while still keeping the core of their message the same. Additionally, it gave them opportunities to see how people perceived the strengths and weaknesses of the proposal, so they could modify it accordingly. By doing so, they were also creating a sense of ownership among those who provided feedback in that they had now contributed and felt a greater investment in pTA's success.

The entrepreneurs also worked to tie pTA to the Asteroid Initiative's goals as well as the Obama administration's initiatives on open government. pTA, thus, was a solution to multiple problems the agency was facing but also followed along with the "politically blessed" initiatives of the past. This strengthened the logical pathway and justified following through with pTA, even though it was a departure from how things were done. Finally, the entrepreneurs used their knowledge of administrative procedures and rules to place themselves in the middle of decision-making process by creating a cooperative agreement with ECAST. This allowed them to not only lead by example, but also to control the decision-making process in the design and implementation as well as the narrative around their work. Importantly, this also placed them in a position to negotiate with other actors, like to OCOMM and OGC, as well as to adapt their proposal around administrative rules or other roadblocks that appeared. In contrast, using a contract with ECAST would have reduced their ability to control how pTA progressed. As a consequence, pTA was able to move forward through the agency as different audiences began to accept this radical new way of engaging the public as part of their policy responsibilities.

This case also highlights the important role played by entrepreneurs in creating opportunities for innovative forms of public participation. Internal knowledge of organizational culture, politics, and bureaucracy was critical to navigating the barriers and challenges to changing how federal agencies approach public participation in program design and decision-making processes in ways ECAST could not have done on its own. It took entrepreneurs within NASA to reinterpret aspects of the Asteroid Initiative so that the AGC could be a vehicle for pTA. This speaks to the importance of "average" bureaucrats taking on an entrepreneurial spirit in pursuing democracy and representation, as well as diversity, equity, and inclusion. Certainly, without the efforts of a few mid-level bureaucrats in NASA, the citizen engagement status quo would likely have remained unchanged since the Apollo missions as entrepreneurial efforts were key to changing how the agency thought about public participation in scientific processes. One can surmise that absent such entrepreneurs in other science-based agencies, citizen participation in scientific decision-making will continue to be lacking greatly across the federal government. Of course, what motivates mid-level bureaucrats to be entrepreneurs is an interesting question. In this case, three of the four entrepreneurs referred to graduate training in science and technology studies and science policy studies as their motivation for supporting pTA in the Asteroid Initiative, but this point needs further examination in order to fully understand the factors that create and motivate these kinds of entrepreneurs.

Importantly, there are three methodological limitations to note about this case study. First, there is a six-year gap between when the Asteroid Initiative's AGC was started in 2013 and when the interviews were conducted with NASA personnel and ECAST members in 2019. While interviewees recalled important impressions and perspectives on the pTA project, specific details may have been lost to time; when interviewees were unsure about details, we worked to specify or corroborate them, or else we did not reference them in this study. Second, there was limited access to NASA managers and leadership. Many of the managers in the directorates and offices involved in the Asteroid Initiative who we were referred to had little interaction with the design and implementation of the pTA itself. Lastly, this case study is an examination of program design and implementation processes in just one U.S. federal agency. It cannot comprehensively speak to all the potential elements that inform the political pressures and administrative challenges entrepreneurs may face in different agencies.

CONCLUSIONS

We find two important theoretical contributions can be derived from this case study. First, the key variable here is how policies are interpreted and how ideas fit within those interpretations. Specifically, NASA entrepreneurs were able to reinterpret policy to provide the justification that pTA fell within the agencies policy responsibilities. From a theoretical perspective, this shines a light on the importance of how and why policies, often left ambiguous by legislative bodies, are interpreted for administrative processes and outcomes. This adds further depth to previous scholarship on ambiguity and policy interpretations in administrative agencies (e.g., Arnold, 2015; Fowler, 2021), but addresses an existing gap around the specific mechanisms by which this is achieved. Second, success or failure of reforms, innovations, or any attempts to change status quos in administrative agencies are often dependent on the skills and energies of entrepreneurs. Administrative agencies are naturally designed and organized to reduce risk by stamping out uncertainties, so it takes an entrepreneurial force to alter the way things are done. Of course, there are tradeoffs and changing the status quo is not always a good thing, as sometimes, we cannot go back if things do not work out as intended (e.g., Terry, 1998). But, it is important to understand the mechanisms required for administrative agencies to modernize, particularly given the social, economic, and political upheaval of recent years.

There are also several pieces of practical advice to derive from this case study. First is focusing on small audiences to build support for a new idea. This allows one to cater messaging, gain feedback, and share ownership of ideas in a narrow space that is not marred by broader organizational politics or the complexities of competition between units or individuals. Catering messaging tends to involve two aspects. On one hand, ideas should be presented so that they play to the special interests of individual audience members; that is, one wants the audience to find benefits and advantages for themselves in an idea. On the other hand, ideas should also follow a rational, logical pathway from existing ways of doing things to reduce risk perceptions; as prospect theory tells us, most people value losses over gains (e.g., Baekgaard, 2017). NASA entrepreneurs accomplished both of these relatively well in the pTA roadshow. Additionally, entrepreneurs are advantaged by having knowledge of organizational culture and rules, so that they can both navigate those rules and not be intimidated by others who may use them as a roadblock. Certainly, this is supported by interactions between our entrepreneurs, OCOMM and OGC, as well as the choice of a cooperative agreement over a contract. Finally, the work of entrepreneurs in administrative agencies never ends, and they must remain engaged on their initiatives until the last step; otherwise, they risk others hijacking the initiative.

Further inquiry is necessary to build on these conclusions though. Foremost, scholars should continue to examine entrepreneurs in administrative processes, and how, through their own initiative, policies are interpreted or re-interpreted. This adds to a growing body of literature that seeks to better conceptualize entrepreneurial activities at a micro-level (e.g., Arnold, 2021), as opposed to the broader debates concerning how entrepreneurs fit into a system of democratic governance (e.g., Bellone & Goerl, 1992). Key here is adding depth and sophistication to understanding entrepreneurial strategies and tactics so that lessons can be transferred to others. For instance, how does one become a successful entrepreneur? And, how do we train future entrepreneurs to pursue innovative changes that advance democracy? By extension, findings also draw questions about success and failure of citizen engagement and public participation within administrative agencies, and whether structural changes are enough without individual energies pushing those initiatives forward. Lastly, the issues here at the science-policy interface also highlight the potential for crosspollination between MSF and Science and Technology Studies (STS) scholarship examining the roles entrepreneurs and “boundary spanners,” respectively, play in the translation and integration of different knowledge and interests (e.g., Bednarek et al., 2018; Goodrich et al., 2020). In sum, administrative entrepreneurs play a significant

role in shaping how organizations come to interpret policy responsibilities and whether they work for or against democratic values, so it is imperative to understand what makes a successful entrepreneur.

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REFERENCES

- Arnold, G. (2015). Street-level policy entrepreneurship. *Public Management Review*, 17(3), 307–327.
- Arnold, G. (2021). Distinguishing the street-level policy entrepreneur. *Public Administration*, 99(3), 439–453.
- Aviv, I., Gal, J., & Weiss-Gal, I. (2021). Social workers as street-level policy entrepreneurs. *Public Administration*, 99(3), 454–468.
- Backgaard, M. (2017). Prospect theory and public service outcomes: Examining risk preferences in relation to public sector reforms. *Public Administration*, 95(4), 927–942.
- Bednarek, A. T., Wyborn, C., Cvitanovic, C., Meyer, R., Colvin, R. M., Addison, P. F., Close, S. L., Curran, K., Farooque, M., Goldman, E., & Hart, D. (2018). Boundary spanning at the science–policy interface: The practitioners' perspectives. *Sustainability Science*, 13(4), 1175–1183.
- Bellone, C. J., & Goerl, G. F. (1992). Reconciling public entrepreneurship and democracy. *Public Administration Review*, 52(2), 130–134.
- Bernier, L. (2014). Public enterprises as policy instruments: The importance of public entrepreneurship. *Journal of Economic Policy Reform*, 17(3), 253–266.
- Bernier, L., & Hafsi, T. (2007). The changing nature of public entrepreneurship. *Public Administration Review*, 67(3), 488–503.
- Campbell, J. L., Quincy, C., Osserman, J., & Pedersen, O. K. (2013). Coding in-depth semistructured interviews: Problems of unitization and intercoder reliability and agreement. *Sociological Methods & Research*, 42(3), 294–320.
- Charmaz, K. (1990). 'Discovering' chronic illness: Using grounded theory. *Social Science & Medicine*, 30(11), 1161–1172.
- Charmaz, K. (2017). The power of constructivist grounded theory for critical inquiry. *Qualitative Inquiry*, 23(1), 34–45.
- Cohen, N., & Aviram, N. F. (2021). Street-level bureaucrats and policy entrepreneurship: When implementers challenge policy design. *Public Administration*, 99(3), 427–438.
- de Vries, H., Bekkers, V., & Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. *Public Administration*, 94(1), 146–166.
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80–92.
- Fowler, L. (2019). Problems, politics, and policy streams in policy implementation. *Governance*, 32(3), 403–420.
- Fowler, L. (2021). How to implement policy: Coping with ambiguity and uncertainty. *Public Administration*, 99(3), 581–597.
- Fowler, L. (2022). Using the multiple streams framework to connect policy adoption to implementation. *Policy Studies Journal*, 50(3), 615–639.
- Goodrich, K. A., Sjostrom, K. D., Vaughan, C., Nichols, L., Bednarek, A., & Lemos, M. C. (2020). Who are boundary spanners and how can we support them in making knowledge more actionable in sustainability fields? *Current Opinion in Environmental Sustainability*, 42, 45–51.
- Goyal, N., Howlett, M., & Chindarkar, N. (2020). Who coupled which stream(s)? Policy entrepreneurship and innovation in the energy–water nexus in Gujarat, India. *Public Administration and Development*, 40(1), 49–64.
- Herweg, N., Zahariadis, N., & Zohlnhofer, R. (2018). The multiple streams framework: Foundations, refinements, and empirical applications. In C. M. Weible & P. A. Sabatier (Eds.), *Theories of the policy process* (4th ed., pp. 25–58). Westview Press.
- Holdren, J. P., P.R. Orszag, & P.F. Prouty. 2009. *President's memorandum on transparency and open government—Interagency collaboration* (Memorandum M09–12; pp. 1–3). Executive Office of the President [online]. <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2009/m09-12.pdf>
- Kaplan, L., Farooque, M., Sarewitz, D., & Tomblin, D. (2021). Designing participatory technology assessments: A reflexive method for advancing the public role in science policy decision-making. *Journal of Technological Forecasting and Social Change*, 171, 120974.

- Kash, D. E., & Rycroft, R. W. (2000). Patterns of innovating complex technologies: A framework for adaptive network strategies. *Research Policy*, 29(7–8), 819–831.
- Kash, D. E., & Rycroft, R. W. (2002). Emerging patterns of complex technological innovation. *Technological Forecasting and Social Change*, 69(6), 581–606.
- Kingdon, J. (1995). *Agendas, alternatives, and public policies* (2nd ed.). Harper Collins.
- Klein, P. G., Mahoney, J. T., McGahan, A. M., & Pitelis, C. N. (2010). Toward a theory of public entrepreneurship. *European Management Review*, 7(1), 1–15.
- Korosec, R. L., & Berman, E. M. (2006). Municipal support for social entrepreneurship. *Public Administration Review*, 66(3), 448–462.
- Lambright, W. H. (2010). Exploring space: NASA at 50 and beyond. *Public Administration Review*, 70(1), 151–157.
- Mack, W. R., Green, D., & Vedlitz, A. (2008). Innovation and implementation in the public sector: An examination of public entrepreneurship. *Review of Policy Research*, 25(3), 233–252.
- Maher, C., Hadfield, M., Hutchings, M., & de Eyto, A. (2018). Ensuring rigor in qualitative data analysis: A design research approach to coding combining NVivo with traditional material methods. *International Journal of Qualitative Methods*, 17(1), 1–13.
- Meijerink, S., & Huitema, D. (2010). Policy entrepreneurs and change strategies: Lessons from sixteen case studies of water transitions around the globe. *Ecology & Society*, 15(2), 21–36.
- Mintrom, M. (1997). Policy entrepreneurs and the diffusion of innovation. *American Journal of Political Science*, 41(3), 738–770.
- Mintrom, M. (2019a). *Policy entrepreneurs and dynamic change*. Cambridge University Press.
- Mintrom, M. (2019b). So you want to be a policy entrepreneur? *Policy Design & Practice*, 2(4), 307–323.
- Mintrom, M., & Norman, P. (2009). Policy entrepreneurship and policy change. *Policy Studies Journal*, 37(4), 649–667.
- Moon, M. J. (1999). The pursuit of managerial entrepreneurship: Does organizational matter? *Public Administration Review*, 59(1), 31–43.
- Nash, S. L., & Steurer, R. (2021). From symbolism to substance: What the renewal of the danish climate change act tells us about the driving forces behind policy change. *Environmental Politics*, 31, 453–477.
- Osborne, D., & Gaebler, T. (1993). *Reinventing government: How the entrepreneurial spirit is transforming the public sector*. Plume.
- Osborne, S. P., & Brown, K. (2005). *Managing change and innovation in public service*. Routledge.
- Peters, B. G., & Savoie, D. J. (1996). Managing incoherence: The coordination and empowerment conundrum. *Public Administration Review*, 56(3), 281–290.
- Petridou, E., & Mintrom, M. (2021). A research agenda for the study of policy entrepreneurs. *Policy Studies Journal*, 49(4), 943–967.
- Pittaway, L., Robertson, M., Munir, K., Denyer, D., & Neely, A. (2004). Networking and innovation: A systematic review of the evidence. *International Journal of Management Review*, 5/6(384), 137–168.
- Rycroft, R. W., & Kash, D. E. (1999). Managing complex networks – Key to 21st century innovation success. *Research Technology Management*, 42(3), 13–18.
- Sclove, R. (2010). Reinventing technology assessment. *Issues in Science & Technology*, 27(1), 34–38.
- Terry, L. D. (1990). Leadership in the administrative state: The concept of administrative conservatorship. *Administration & Society*, 21(4), 395–412.
- Terry, L. D. (1993). Why we should abandon the misconceived quest to reconcile public entrepreneurship with democracy: A response to Bellone and Goerli's "Reconciling Public Entrepreneurship and Democracy?". *Public Administration Review*, 53(4), 393–395.
- Terry, L. D. (1998). Administrative leadership, neo-managerialism, and the public management movement. *Public Administration Review*, 58(3), 194–200.
- Terry, L. D. (2003). *Leadership of public bureaucracies: The administrator as conservator*. Sage.
- U.S. National Aeronautics and Space Administration. 2013a. *Asteroid initiative request for information (Solicitation No. NNH13ZCQ001L)*. Government Publishing Office. <http://www.spaceref.com/news/viewsr.html?pid=44217>
- U.S. National Aeronautics and Space Administration. 2013b. *Asteroid RFI generates substantial interest from the public* [online]. Government Publishing Office. <https://www.nasa.gov/content/asteroid-rfi-generates-substantial-interest-from-the-public/>
- Vigoda-Gadot, E., Shoman, A., Schwabsky, N., & Ruvio, A. (2008). Public sector innovation for Europe: A multinational eight-country exploration of citizens' perspectives. *Public Administration*, 86(2), 307–329.

- Wiley, K. K., & Berry, F. S. (2015). Teaching social entrepreneurship in public affairs programs: A review of social entrepreneurship courses in the Top 30 U.S. public administration and affairs programs. *Journal of Public Affairs Education*, 21(3), 381–400.
- Zahariadis, N. (2003). *Ambiguity and choice in public policy: Political decision making in modern democracies*. Georgetown University Press.
- Zahariadis, N. (2005). *Essence of political manipulation: Emotion, institutions, & greek foreign policy*. Lang.
- Zahariadis, N., & Exadaktylos, T. (2016). Policies that succeed and programs that fail: Ambiguity, conflict, and crisis in greek higher education. *Policy Studies Journal*, 44(1), 59–82.
- Ziens, J. 2010. *Guidance on the use of challenges and prizes to promote open government* (Memorandum M-10–11; pp. 1–12). Office of Management and Budget [online]. <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2010/m10-11.pdf>
- Zohlnhofer, R., & HuB, C. (2016). How well does the multiple streams framework travel? Evidence from German case studies. In R. Zohlnhofer & F. W. Rub (Eds.), *Decision-making under ambiguity and time constraints: Assessing the multiple-streams framework* (pp. 169–188). ECPR Press.

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