8-2022

# The imaginary and epistemology of disaster preparedness: The case of Japan's nuclear safety failure

Hiro SAITO
*Singapore Management University*, hirosaito@smu.edu.sg

Poetics xxx (xxxx) xxx

Contents lists available at ScienceDirect

Poetics

journal homepage: www.elsevier.com/locate/poetic

# The imaginary and epistemology of disaster preparedness: The case of Japan's nuclear safety failure

Hiro Saito *

*Singapore Management University, School of Social Sciences, 90 Stamford Road, Level 4, 178903, Singapore*

ARTICLE INFO

*Keywords:*
Developmental state
Disaster governance
Organizational failure
Political economy
Regulatory capture
Science and technology studies

ABSTRACT

The Fukushima nuclear disaster was profoundly a man-made one, resulting from the organizational failure of nuclear emergency preparedness. To fully understand the cause of this disaster, I propose to extend an organizational perspective on disasters into a macro-institutional perspective on disaster preparedness. To this end, I borrow from science and technology studies the concepts of "sociotechnical imaginary" and "civic epistemology" to probe the deepest layers of meaning-making constitutive of disaster preparedness. I then apply these concepts to the history of nuclear energy in postwar Japan that was centered on the developmental state pursuing industrial transformation. Specifically, I illustrate how the "pacifist imaginary" emphasized positive contributions of "the peaceful use of nuclear energy," legitimating a priori the promotion of nuclear power as a means of economic development; and how the "technocratic epistemology" invoked the superior competencies of state bureaucrats and expert advisers, legitimating post hoc their disregard for the possibility of a severe accident. The imaginary and epistemology thus enabled the developmental state to pursue pro-nuclear policy by securing acquiescence from the majority of citizens and discrediting the minority of antinuclear activists – until the earthquake and tsunami exposed the preparedness failure in March 2011.

Two decades ago, leading disaster researchers observed that *preparedness* had been largely left out of "most disaster research, which… focused mainly on *pre-, trans-*, and *immediate post-impact* response activities" (Perry et al., 2001: 22; emphasis in original). But today, preparedness – creating a set of social and technical measures to minimize potential disaster losses – is an important topic in disaster research, as the number of disasters has surged around the world against the backdrop of climate change, including but not limited to, hurricanes, wildfires, heatwaves, and droughts (Klinenberg, 2015; Perrow, 2007; Tierney, 2019). As more and more people accept this immanence and imminence of disasters in the face of the unfolding "climate catastrophe" (Beck, 2016), preparedness is now regarded as a policy imperative with enormous ramifications for human life and livelihood (Rodríguez et al., 2018; Rodríguez et al., 2007).

In addition to such far-reaching practical implications, preparedness has theoretical importance for disaster researchers, for it is a key concept in the emerging field of "disaster governance" (Tierney, 2012). Because *governance* involves collaborations among government agencies, industries, local communities, and other relevant actors across multiple domains of society, it prompts disaster

For their helpful comments on earlier versions of this paper, I thank the anonymous reviewers, Kean Birch, Les Levidow, Ming-Cheng Lo, Sergio Sismondo, and Bin Xu. This research was supported by the Singapore Management University School of Social Sciences Discretionary Account for Research and Teaching (DART) Fund and the Singapore Ministry of Education (MOE) Academic Research Fund (AcRF) Tier 1 grant.

* Corresponding author.
*E-mail address:* hirosaito@smu.edu.sg.

https://doi.org/10.1016/j.poetic.2021.101594
Received 11 January 2021; Received in revised form 27 June 2021; Accepted 30 June 2021
Available online 17 July 2021

researchers to extend a meso-level perspective on *organizational* cognitions and behaviors into a *macro-institutional* one (Tierney, 2007; Vaughan, 1999) – namely, to investigate how hard and soft infrastructures, encompassing back-up power supplies, regulatory agencies, and social networks and support, to name but a few, are assembled to increase disaster resilience at the societal level.

This paper thus aims to contribute to the field of disaster governance by examining the Fukushima nuclear disaster as a case of *preparedness failure* – quintessentially a "man-made disaster" that happened as the result of accumulation of organizational failures over a long "incubation" period (cf. Turner & Pidgeon, 1997). Such a long-in-the-making disaster provides rich historical data to help theorize how the preparedness component of disaster governance failed in light of the patterns of interactions among government agencies, electric power companies, hosting municipalities, and other relevant stakeholders in nuclear safety. In addition, this case study offers insights into how to best govern future uncertainties that cannot be reduced to calculable risks (Beck, 2009; Callon et al., 2009), for the nuclear disaster foreshadowed the growing risk of nuclear energy in the age of climate change. Just as the Fukushima Daiichi Nuclear Power Plant was hit by the historically unprecedented earthquake and tsunami, "as climate changes, past events are becoming an increasingly inappropriate basis for the prediction of the severity of future events" (International Atomic Energy Agency, 2019: 23). To make these theoretical and practical contributions to disaster governance, let me first establish the baseline understanding of the nuclear disaster in the section below.

## 1. The Fukushima nuclear disaster as an organizational failure of preparedness

Among various investigative reports published to date, I draw on the ones by the Rebuild Japan Initiative Foundation (RJIF), the Investigation Committee (IC) of the Cabinet Office, and the National Diet Independent Investigation Commission (NAIIC) because they are the most comprehensive.[1] Although none of these reports was able to pinpoint the direct cause of the nuclear disaster due to a lack of sufficient information on the damaged nuclear reactors, they all agreed that the Tokyo Electric Power Company (TEPCO) and the government had failed to achieve an adequate level of nuclear emergency preparedness, especially severe accident management (IC, 2012; NAIIC, 2012a; RJIF, 2012).

This failure of nuclear emergency preparedness, according to the three investigative reports, resulted from the peculiar organizational framework of Japan's nuclear safety: the regulatory agency Nuclear and Industrial Safety Agency (NISA) was a subsidiary of the Ministry of Economy, Trade and Industry (METI) responsible for promoting nuclear power. This organizational framework severely compromised NISA's regulatory independence: since elite bureaucrats who occupied top positions at NISA were arranged to rotate back to pro-nuclear METI after 2–3 years, they were unmotivated to enforce nuclear safety that would cost electric power companies additional time and expenses for installing new safety measures, which would negatively affect METI's pro-nuclear policy (RJIF, 2012). In fact, these elite bureaucrats at NISA were incapable of acquiring sufficient expertise to regulate electric power companies because of the short duration of their appointment (IC, 2012; NAIIC, 2012b). This was why NISA left severe accident management to electric power companies by declaring "the accident management… shall be considered and implemented by the operators based on their 'technical competency' and 'expertise', but shall not require authority to regulate the specific details of measures" (quoted in NAIIC, 2012a: 28). Given its organizational subordination to pro-nuclear METI, NISA lacked the authority, capability, and will to enforce nuclear safety on TEPCO, resulting in what the NAIIC report (2012a: 43) called "regulatory capture" in which "the oversight of the industry by regulators effectively ceases."

In this regard, the Fukushima nuclear disaster was "a profoundly manmade" one (NAIIC, 2012a: 9), as "organizational learning" as a prerequisite of disaster preparedness (Pidgeon & O'Leary, 2000; Turner & Pidgeon, 1997) had been disabled by regulatory capture. Indeed, such a preparedness failure can be particularly catastrophic with nuclear power generation – one of the highest-risk technologies that involve complex interactions and tight coupling of system components (Perrow, 1999). Despite this "inherent" systemic vulnerability, NISA not only lacked regulatory independence but also routinized its "symbiotic interdependence" with electric power companies (cf. Vaughan, 1996), while producing numerous "fantasy documents" (Clarke, 1999) regarding safety standards to rationalize the inadequate level of nuclear emergency preparedness.

Nevertheless, this *organizational* perspective on the preparedness failure begs the question: why did Japan's nuclear safety develop such an organizational framework, highly prone to regulatory capture, to begin with? This is why, as suggested by various researchers (Clarke & Short, 1993; Tierney, 2007; Vaughan, 1999), organizational studies of disasters should be extended to adopt a *macro-institutional* perspective to contextualize organizational failures within the wider society.

## 2. Toward a macro-institutional explanation

Indeed, existing research offers at least two competing macro-institutional explanations of the preparedness failure. One is *political-economic*, tracing the cause of regulatory capture to the "nuclear village," an extensive network of actors in national and local governments, energy, manufacturing, and construction sectors, mass media, and universities, that collaborated to promote nuclear power at the expense of nuclear safety (Funabashi et al., 2012; Komatsu, 2012; Yoshioka, 2011). Simply put, electric power companies used profits made of nuclear power to make monetary contributions to politicians, pay newspaper and broadcasting companies to advertise the benefits of nuclear energy, and provide funding for researchers in nuclear-related fields. Electric power companies also created lucrative advisory positions for retired senior bureaucrats from energy-related ministries and agencies in returning favors for the

[1] A list of all investigative reports on the Fukushima nuclear disaster is available from the School of Engineering at the University of Tokyo (Itoi Laboratory, 2012).

government's pro-nuclear policies. In short, the huge amount of power and money involved in nuclear power generation motivated the governments, electric power companies, and other relevant actors to prioritize the promotion of nuclear power over the enforcement of nuclear safety.

An alternative explanation is *ethno-cultural*, attributing the cause of the preparedness failure to allegedly distinct "Japanese culture." Such an ethno-cultural explanation was spearheaded by NAIIC Chairman Kurokawa Kiyoshi: "What must be admitted – very painfully – is that this was a disaster 'Made in Japan.' Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity" (NAIIC, 2012a: 9). This line of thinking has been endorsed by cultural theorists who traced the root cause of regulatory capture to "the subject-less structure of the Japanese language" (Niigata, 2014), "the Tokyo-University narrative techniques" (Yasutomi, 2012), and other linguistic and behavioral conventions that purportedly bred the uniquely Japanese mindset of groupthink and irresponsibility (Kurokawa, 2016). In essence, this explanation turns upside down the popular genre of "Nihonjinron" (Befu, 2001; Yoshino, 1992), invoking the essence of the Japanese people as a cause of the disastrous outcome rather than of successful ones like the postwar "economic miracle."

Both explanations lack empirical rigor, however. On the one hand, the political-economic explanation is too crude in its treatment of history. For example, when the Japanese government established the Atomic Energy Commission (AEC) in January 1956 to promote the civilian use of nuclear energy, a commercially viable nuclear power plant – a source of power and money as the basis of the nuclear village – was unavailable. In fact, the nuclear village became a formidable political-economic force only after the 1973 oil crisis prompted the government to promote nuclear energy as a main alternative to oil. Equally important, until the government created the Nuclear Safety Commission (NSC) in October 1978, Japan had no government agency dedicated to nuclear safety. The situation of Japan's nuclear safety prior to the 1970s, then, was worse than "regulatory capture" because there was no regulatory agency to be captured in the first place. The political-economic explanation thus fails to address the historical fact that Japan's nuclear safety had been severely compromised long before the consolidation of the nuclear village. On the other hand, the ethno-cultural explanation invokes the essentialist concept of "Japanese culture," which is problematic in two respects. First, given the existence of a globally shared technological culture of nuclear energy that compromises the practice of nuclear safety by discursively downplaying the risk of nuclear accident (Downer, 2014; Perrow, 2013), this explanation is unable to illuminate what might have been culturally distinct about Japan's nuclear safety vis-à-vis the globally isomorphic force of science and technology (Drori et al., 2002; Meyer, 2010). Second, and equally important, it fails to explain how allegedly unique cultural attributes were formed, disseminated, and reproduced to give rise to regulatory capture specifically in nuclear safety, and not in other policy domains.

Despite these limitations, the two macro-institutional explanations of the preparedness failure are moving in the direction consistent with the growing field of research on disaster governance that examines disaster preparedness and response in terms of multi-level collaborations among government agencies, industries, local communities, research institutes, and other relevant organizations across multiple domains of society (Perry et al., 2001; Tierney, 2012, 2014, 2019). The political-economic explanation contextualizes the nuclear disaster within the broader network of interactions that extend far beyond the regulatory agency and electric power companies, whereas the ethno-cultural one connects organizational cognitions and behaviors at the meso level to cultural systems of signs and symbols at the macro level (cf. Clarke, 2005; Weart, 2012). Given their potential to make an important contribution to disaster governance, then, I propose to consolidate the two macro-institutional explanations into a more rigorous one by borrowing two concepts – "sociotechnical imaginary" (Jasanoff & Kim, 2009, 2015) and "civic epistemology" (Jasanoff, 2005; Miller, 2008) – from science and technology studies (STS).

## 3. Theorizing the culture of disaster preparedness

These two STS concepts, advanced by Sheila Jasanoff and her colleagues in the Science and Democracy Network, aim to illuminate how science and technology policymaking is influenced by the deepest layers of culture: "imaginary" provides humans with a vision of how the universe has been created and ordered and hence the ontological basis of constituting a society (Castoriadis, 1987; Taylor, 2004), whereas "epistemology" provides humans with the "right way" to know the reality of their universe and use this knowledge as the rational basis of their decisions and actions (Foucault, 1980; Latour, 1999). Specifically, *sociotechnical imaginaries* consist of "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff & Kim, 2015: 4). Because sociotechnical imaginaries are lodged "in the hearts and minds of human agents and institutions" (17), they decisively shape people's affective, normative, and cosmological understandings of desirable and undesirable kinds of science and technology for their societies. *Civic epistemologies* then refer to "the institutionalized practices by which members of a given society test and deploy knowledge claims used as a basis for making collective choices', that is, 'tacit knowledge-ways through which they assess the rationality and robustness of claims that seek to order their lives" (Jasanoff, 2005: 255). Generally, these epistemologies have six dimensions: "(1) the dominant styles of public knowledge-making; (2) the methods of ensuring accountability; (3) the practices of public demonstration; (4) the preferred registers of objectivity; (5) the accepted basis of expertise; and (6) the visibility of expert bodies" (259).

I argue that these deeply cultural concepts can help the political-economic and ethno-cultural explanations overcome their common weakness: a lack of rigor in theorizing the constitutive role of "culture" in disaster preparedness, which results in an unsatisfactory empirical analysis of how macro-institutional factors led to the preparedness failure at the organizational level. On the one hand, the concept of sociotechnical imaginary suggests that the political-economic explanation should be extended to examine how the formation of the nuclear village was fundamentally mediated by a certain sociotechnical imaginary of nuclear energy in Japan, and that

the ethno-cultural explanation should focus on this imaginary dimension of "Japanese culture" as most pertinent to the emergence of regulatory capture in nuclear safety. On the other hand, the concept of civic epistemology suggests that the political-economic explanation should pay attention to the role of knowledge vis-à-vis power and money in the legitimation of nuclear energy policies, and that the ethno-cultural explanation should specify a causal link between this epistemic dimension of "Japanese culture" to the organizational failure of Japan's nuclear safety.

Importantly, these two cultural concepts also help contextualize the preparedness failure within the distinct trajectory of the Japanese "developmental state" (Johnson, 1982, 1999), a particular type of the state that deploys market-conforming interventions to develop chosen industries to become internationally competitive while transforming the structures of the national economy as a whole (Woo-Cumings, 1999). Although this concept has been mostly used in political-economic research that often downplays the explanatory power of culture, an increasing number of researchers in sociology, political science, and STS now recognize that any state-making is fundamentally coterminous with meaning-making (e.g., Jasanoff, 2004; Morgan & Orloff, 2017; Steinmetz, 1999). Similarly, recent studies of developmental states have begun to focus explicitly on beliefs, desires, and visions – the "cultures of development," as it were – that motivate policymakers to pursue industrial transformations of their societies (Thurbon, 2016; Woo, 2018).

Indeed, such importance of culture was already recognized, at least implicitly, in the earliest studies of developmental states. As Chalmers Johnson (1999: 37) observed, "[f]or more than 50 years the Japanese state has given its first priority to economic development," and such a consistent policy orientation was fundamentally motivated by what Manuel Castells (1992: 57, 66) called the "messianic dreams" of "a fundamental transformation of the economic order" – namely, a certain *imaginary* of modern industrial society. Moreover, because the first element of the developmental state was "the existence of a small, inexpensive, but elite state bureaucracy staffed by the best managerial talent available in the system" (Johnson, 1999: 38), its *epistemology* of policymaking was "more technocratic than bureaucratic" (Castells, 1992: 64), legitimating the role – and the rule – of experts as the bearers of relevant technical knowledge that citizens are supposed to lack (Fischer, 1990).

In short, the concepts of sociotechnical imaginary and civic epistemology, applied to the historical context of the Japanese developmental state, have the potential to illuminate the cultural dimension of nuclear emergency preparedness. Specifically, the two STS concepts help answer the following two questions: what kind of imaginary and epistemology emerged under the purview of the Japanese developmental state, and how did they influence the organizational framework of Japan's nuclear safety to permit regulatory capture to persist until March 2011, when the earthquake and tsunami exposed the failure of nuclear emergency preparedness?

## 4. Method and data

To answer the questions, I have examined three sets of publicly available historical data from 1945 to 2015.[2] First, because state actors play a leading role in nuclear governance (Flam, 1994; Hecht, 2009; Jasper, 1990), especially in the context of developmental states (Hsu, 2005; Lee, 2020; Saito, 2021a), I have reviewed policy documents on nuclear energy that are digitally archived by relevant government ministries and agencies, such as AEC (1956–), NSC (1978–2012), NISA (2001–2012), Agency for Natural Resources and Energy (1973–), and METI (2001–).[3] These policy documents illuminate the *contents* of imaginaries and epistemologies of nuclear energy that state bureaucrats used to regulate nuclear safety and *how* they *formed* over time.

Then, to understand the *how* and *why* of these contents and their formations, I have examined the National Diet proceedings, which document how politicians, from both the ruling and opposition parties, negotiated diverse economic, social, and safety concerns among their constituencies, including but not limited to, electric power companies, local governments, and nongovernmental organizations (NGOs). Tracing these political negotiations helps clarify how and why a certain imaginary and epistemology came to dominate the organizational framework of Japan's nuclear safety. In a way, the National Diet proceedings are more important than the first set of data because state bureaucrats formulated industrial policies within the overall policy orientation of development that has been set by the ruling Liberal Democratic Party (Inoki, 2013) – and this political initiative was particularly strong in the domain of energy policy, given its foundational importance to economic growth that preoccupied postwar Japanese society (Ōta, 2014; Takeda, 2018).

Finally, to complement these two sets of historical data on state bureaucrats and politicians, I have used the digital archives of the two largest national newspapers in Japan, *Asahi shinbun* and *Yomiuri shinbun*, to understand how the industry and the civil society – two other important actors in nuclear governance – responded to, as well as tried to influence, the government's nuclear energy policies. As a supplement, I also reviewed opinion polls on nuclear energy that both governmental and nongovernmental organizations conducted. These newspaper articles and opinion polls clarify how widely the dominant imaginary and epistemology of nuclear energy were shared at the societal level.

[2] Below, my historical analysis starts with the end of the Second World War in August 1945, when the developmental state began to consolidate, free from the military's interference. Although my analysis focuses on the period prior to the nuclear disaster in March 2011, it also touches on the post-disaster period until 2015 to check whether and how the disaster affected the dominant imaginary and epistemology of nuclear energy.

[3] Policy documents I have examined include the following: Atomic Energy White Paper; Nuclear Safety White Paper; Energy White Paper; Long-term Plans for Nuclear Energy Research, Development, and Utilization; and minutes and reports of Advisory Committee for Natural Resources and Energy as well as other energy-related committees at Agency for Natural Resources and Energy and METI. To supplement these documents, I have also reviewed policy statements and court rulings digitally archived in Japan Atomic Energy Agency's Nuclear Energy Encyclopedia ATOMICA, the Cabinet Office, and the e-Gov and Courts-in-Japan database.

To be sure, these data on state bureaucrats, politicians, the industry, and the civil society have been used by Japanese historians and social scientists (e.g., Akimoto, 2014; Yamamoto, 2015; Yoshimi, 2012; Yoshioka, 2011) to illuminate the history of nuclear energy in Japan, and this paper owes much to this existing scholarship. Nonetheless, this paper also makes a unique contribution by focusing on the cultural dimension of the developmental state and causally tracing macro-institutional pathways that led to the organizational failure of nuclear emergency preparedness at the Fukushima Daiichi. Hence, the following empirical analysis starts with the Japanese developmental state formation in the mid-twentieth century.

## 5. The pacifist imaginary as a priori legitimation

As Johnson (1999: 41) observed, "The Japanese case is actually one of an economy mobilized for war but never demobilized during peacetime." Indeed, a developmentalist imaginary already existed in Japan in the first half of the twentieth century in the form of "scientific nationalism," which defined science and technology as "the most urgent and important assets for the integrity, survival, and progress of the nation" (Mizuno, 2008: 181). Under the purview of such an imaginary, a large number of scientists and engineers had been mobilized for the construction of infrastructures across the Japanese empire (Tanaka, 2006) as well as for research and development of weapons (Ikeuchi, 2016). Importantly, this developmentalist imaginary was reinforced after the Second World War. Having established the new constitution to "forever renounce war as a sovereign right of the nation," the government began to promote science as a means to reconstruct Japan as a "democratic, civilized, and peaceful nation" based on the diagnosis that "the underdevelopment of science – and rational thinking associated with it – had permitted militarism and extreme nationalism" to lead Japan into the wrongful war (Ministry of Education, 1946: 7).

This developmentalist imaginary began to focus on nuclear energy after the US government proposed the "Atoms for Peace" program in December 1953. This US-led international program intersected with the domestic debate on the creation of the Science and Technology Agency (STA), for the Japanese government considered "100 percent utilization of science and technology is indispensable for us, a resource-poor nation, to improve the living standard of our people" (House of Councillors, 1953). Indeed, the government headed by the Liberal Party was keen to acquire nuclear technology through the Atoms for Peace program and collaborated with the Reformist Party, proposing to fund research on nuclear energy "to keep up with the third industrial revolution driven by nuclear energy" (House of Representatives, 1954a).

Just then, it was reported that the crew of the Japanese fishing boat Lucky Dragon 5 suffered acute radiation sickness from the fallout of a hydrogen bomb near Bikini Atoll in early March, and that the tuna they had brought back showed high levels of radiation. The shock of the so-called Lucky Dragon 5 incident reverberated across Japan to the extent that all forty-six of the country's prefectural councils passed antinuclear resolutions between March and October 1954 (Hiroshima City, 1982: 121). Both houses of the National Diet also unanimously adopted the resolution to demand international management of nuclear energy and ban nuclear weapons, highlighting Japan's historic mission as "the only nation in the world that suffered from nuclear weapons," to promote "the peaceful use of nuclear energy" worldwide (House of Councillors 1954; House of Representatives, 1954b). Concurrently, *Asahi shinbun* (1954) and *Yomiuri shinbun* (1954) emphasized the importance of "using nuclear energy for peace" as a lesson to be drawn from the Lucky Dragon 5 incident vis-à-vis the atomic bombings of Hiroshima and Nagasaki. Given such widespread support for the civilian use of nuclear energy, the government proceeded to sign a nuclear cooperation agreement with the United States in November 1955 to import nuclear technology and fuels necessary for operating research reactors inside Japan.

Then, in the following month, the government, now headed by the Liberal Democratic Party (LDP), created the Atomic Energy Basic Act to "promote research, development, and use of nuclear energy to secure future energy sources, facilitate scientific progress and industrial development, and contribute to the welfare of humankind and the living standard of Japanese citizens" (e-Gov, 1955). Celebrating the establishment of AEC based on the act, its first chairman Shōriki Matsutarō of the LDP emphasized, "The fact that Japan, the first and only victim of atomic bombing, should now embark upon her national enterprise for the peaceful utilization of atomic energy, is of a vast significance, I believe, not only to our country alone but also to the entire world" (AEC, 1956a).[4]

Mass media enthusiastically supported the government's pro-nuclear initiative. Between November 1955 and June 1957, Yomiuri Shinbun and other newspaper companies hosted the Exposition for the Peaceful Use of Nuclear Energy in ten different cities in Japan, attracting more than 2.6 million visitors (Yamamoto, 2015: 43−44). This Expo showcased possible innovations based on the civilian use of nuclear energy, ranging from nuclear power plants to nuclear-powered trains, ships, and airplanes, impressing visitors with the image of nuclear energy as "dream technology" (Yamamoto, 2012: 4). Given these positive representations, 92 percent of the Expo attendees in Tokyo agreed that "the peaceful use of nuclear energy in Japan will contribute to the happiness of Japanese society" (Yomiuri shinbun, 1955). Indeed, when the government conducted an opinion poll in 1969, 65 percent of the respondents supported "the active promotion of the peaceful use of nuclear energy," whereas about 5 percent opposed it (Cabinet Office, 1969).

Put another way, Japan's *pacifist imaginary* of nuclear energy emerged around the binary opposition "sacred = civilian vs. profane = military," when the 1954 Lucky Dragon 5 incident produced the conjuncture of memories of Hiroshima and Nagasaki, the

[4] To be sure, some politicians and state bureaucrats also had a "realist" imaginary of nuclear energy. As documented by Japanese historians and journalists (e.g., Arima, 2012; Ōta, 2014), various LDP members considered civilian nuclear programs, especially fuel reprocessing, as the key to acquiring the capability to potentially develop nuclear bombs and using this potential capability as a deterrent. The Ministry of Foreign Affairs, too, circulated a policy memo in 1969, proposing to "maintain the economic and technological potentials to develop nuclear weapons while carefully keeping other countries from restricting these potentials" (reprinted in Ministry of Foreign Affairs, 2010: 4). But this realist imaginary was held only by a minority of politicians and state bureaucrats, and the pacifist one remained dominant.

nationwide antinuclear movement, and the pacifist project of postwar nation-rebuilding steered by the developmental state (Saito, 2021b). Importantly, this imaginary provided *a priori legitimation* for the civilian use of nuclear energy: in contrast with the military and dangerous use of nuclear energy, the civilian and peaceful use could only benefit the world and hence should be harnessed for the prosperity of humanity. Perhaps this imaginary was most clearly articulated by the Japan Atomic Industrial Forum, the national industry association of nuclear-related businesses that closely collaborated with the government. To promote the commercial use of nuclear energy, the forum celebrated the promise of nuclear energy "to bring unlimited prosperity and happiness by forever solving humanity's concern about energy resources indispensable for its existence" (Japan Atomic Industrial Forum, 1959: 5).

This pacifist imaginary consolidated in the 1970s, as Japan proceeded to sign and ratify the Treaty on the Non-Proliferation of Nuclear Weapons. This process was initially hampered by the widespread concern about how the treaty might jeopardize Japan's national mission to advance the civilian use of nuclear energy (Takeda, 2018: chs.2–3), specifically its long-term goal to construct a "fast breeder reactor" vis-à-vis a "closed fuel cycle." This goal had been central to Japan's civilian nuclear programs from the very beginning because a fast breeder reactor was supposed to produce excess plutonium during its operation, which then could be recycled into new fuels to be fed back into it: such a self-perpetuating closed fuel cycle was envisioned as a solution to the low level of Japan's energy self-sufficiency (AEC, 1956b). The problem, however, was that the closed fuel cycle required major fuel reprocessing facilities, which could be repurposed to produce nuclear bombs. This was why the Japanese government had to convince the other signatory countries about its commitment to recycle spent fuels exclusively for a fast breeder reactor, so that "our country's peaceful use of nuclear energy will not be unfairly restricted by the treaty" (House of Councillors, 1970). Thus, through the process of treaty ratification, politicians and state bureaucrats reinforced Japan's national mission to promote the "peaceful use of nuclear energy" (House of Councillors, 1976).

To be sure, a small number of citizens began to question the pacifist imaginary in the 1970s against the backdrop of Minamata disease and other health problems caused by growing environmental pollution. These citizens filed lawsuits to stop the construction of nuclear power plants by arguing that "the peaceful use of nuclear energy" did not guarantee nuclear safety, and that nuclear power plants endangered the lives of local residents (Kaido, 2011). Similarly, according to various opinion polls conducted by the government and newspaper companies, the percentage of citizens who recognized the danger of nuclear power steadily increased from the 1980s through the 1990s, due to the 1986 Chernobyl disaster and the 1995 Monju sodium leak accident. For example, opinion surveys (1989–1998) by the Energy and Information Technology Research Foundation (reprinted in Shibata & Tomokiyo, 1999: ch. 4) found that about 60 percent of the respondents thought a severe accident like the Chernobyl disaster could happen in Japan; at the same time, however, 60–70 percent of them also thought that nuclear power was necessary to meet Japan's electricity demand. In fact, the growing concern about the danger of nuclear power did not significantly undermine the pacifist imaginary: in 2010, nearly 80 percent of respondents still believed that Japan should vigorously promote the "peaceful use of nuclear energy" precisely because the country had been victimized by nuclear weapons (Japan Atomic Energy Relations Organization, 2010).

As the majority of citizens remained supportive of the pacifist imaginary, the number of nuclear reactors and their generating capacities continued their linear growth between the 1970s and the mid-1990s (Yoshioka, 2011: 143), which increased the share of nuclear power in Japan's total electricity generation to 34 percent in 1995 and made the country more dependent on nuclear energy than any other energy sources (Agency for Natural Resources and Energy, 2017). In 2006, the government even created "the Plan for Developing the Nation through Nuclear Power" to celebrate nuclear energy for "its contribution to meet the growing energy demand worldwide and prevent global warming" while aiming to raise the share of nuclear power beyond 40 percent of Japan's total electricity generation as well as export nuclear technology to developing countries (Japan Atomic Energy Agency, 2006). Such pro-nuclear policy was maintained after the Democratic Party of Japan (DPJ) ousted the LDP in 2009. When the DPJ government revised the Basic Energy Plan – the most important policy document that defined Japan's mid- and long-term energy strategies – in 2010, it proposed to construct fourteen new nuclear reactors in addition to the existing fifty-four, reaffirming Japan's commitment to "contribute to the healthy advancement of the peaceful use of nuclear energy worldwide" (Agency for Natural Resources and Energy, 2010: 27).

In short, the pacifist imaginary introduced a significant bias into Japan's nuclear safety by institutionalizing the binary opposition "sacred = civilian vs. profane = military" as part and parcel of the developmental state formation. This one-sidedly positive image of the civilian use of nuclear energy made it difficult for politicians, state bureaucrats, citizens, and other stakeholders to imagine and prepare for negative eventualities like nuclear disasters. In this sense, the pacifist imaginary provided a priori legitimation for the promotion of nuclear power by defining the civilian use as inherently beneficial and hence precluding consideration of its detrimental potential.

Nonetheless, this imaginary dimension constitutes only the first part of the proposed macro-institutional explanation of the preparedness failure at the Fukushima Daiichi. The explanation is complete only with the following second part that clarifies another cultural dimension of the developmental state – its *technocratic epistemology*.

## 6. The technocratic epistemology as post hoc legitimation

In essence, the technocratic epistemology of the Japanese developmental state legitimates expertise as the basis of policymaking and authorizes bureaucrats and their expert advisers to formulate policies on behalf of citizens (Iio, 2007; Saito & Pahk, 2016; Shindo, 2012). Historically, this high level of "Weberianness" (Evans & Rauch, 1999) of the Japanese state bureaucracy traces back to the late nineteenth century when the government began to establish imperial universities to "conduct research and teaching on the arts and science that meet the essentials of the state" (reprinted in Ministry of Education, 1972: 363) and staffed the state bureaucracy with graduates of these prestigious universities as experts in statecraft, i.e. technocrats capable of building both hard and soft infrastructures of the modern state (Amano, 2009; Nakayama, 1978). Importantly, such epistemic authority of the state bureaucracy was strengthened

decisively after the Second World War: the military – one of the most powerful political actors in prewar Japan – was formally dismantled with the new "pacifist constitution," giving the state bureaucracy the greater authority and freedom to initiate and implement policies (Johnson, 1982). In turn, the majority of citizens accepted this technocratic epistemology, so long as the developmental state continued to achieve an adequate level of economic growth and redistribute its benefits across the population (Castells, 1992; Johnson, 1999). In this regard, the dominant civic epistemology in Japan was peculiarly *statist*.

This epistemology was pronounced in the policy domain of nuclear energy because nuclear power generation was perceived as one of the most complex technological systems (Perrow, 1999). For example, because the first AEC Chairman Shōriki thought that "nuclear power indeed involves the most advanced science and technology" (House of Councillors, 1956), he appointed Yugawa Hideki, the Japanese physicist and Nobel laureate, as an AEC member. Sasaki Yoshitake, the director of STA Nuclear Power Bureau, also insisted "the current members of AEC are the best in Japan… and they administer nuclear energy policy with the extremely high level of competence" (House of Councillors, 1959). Members of the opposition, too, shared the view that "nuclear energy is at the top of the pyramid of science" and "its management requires AEC to have the highest level of scientific rigor" (House of Representatives, 1956, 1958).

Such a technocratic epistemology of nuclear energy was mobilized to guarantee nuclear safety after the 1973 oil crisis prompted the government to turn to nuclear energy as a main alternative to oil that had made up more than 70 percent of Japan's energy sources. To justify the construction of new nuclear power plants by emphasizing their safety, AEC Chairman Moriyama Kinji of the LDP asserted, "Precisely because the peaceful use of nuclear energy has a short history, nuclear power generation is equipped with the latest technologies, including multilayer-protection mechanisms that ensure safety" (House of Representatives, 1974). Although Moriyama's assertion was soon undermined by a radiation leak from the nuclear vessel Mutsu in September 1974, the government used this accident to create NSC by taking the American Nuclear Regulatory Commission as a model. As the director of STA Nuclear Safety Bureau Makimura Nobuyuki explained, NSC would improve Japan's nuclear safety by exclusively focusing on nuclear safety independent of AEC and "double-checking" safety reviews conducted by nuclear-related government agencies, while utilizing "a high level of scientific and technological expertise" of its members (House of Representatives, 1978). Although the opposition parties questioned the effectiveness of NSC, they eventually endorsed its creation with their additional resolution to require NSC members to have "the ability to carry out authoritative safety reviews" (House of Councillors, 1978).

This technocratic epistemology of nuclear energy was further reinforced through a series of legal battles between the government and antinuclear activists. While the activists exposed various legal and technical problems with Unit 1 of the Ikata Nuclear Power Plant (Gijutsuto ningen, 1978), their claim was vigorously rejected by the Matsuyama District Court (1978) that asserted the epistemic authority of the state over citizens: "because permission for the construction of a nuclear reactor requires a particularly advanced level of scientific and expert knowledge, it is entrusted to the state [that] is equipped with all pertinent information of nuclear safety and numerous experts, in contrast with the plaintiff… whose expert knowledge is normally far inferior." This technocratic epistemology was later confirmed by the Supreme Court of Japan (1992) that declared the safety of nuclear reactors was warranted by "the rational judgment of the prime minister who respects scientific and technical knowledge of the Atomic Energy Commission that includes experts in relevant fields." Throughout these legal battles, the government continued to insist on its "infallibility" in the domain of nuclear energy policy (NAIIC, 2012b: 549) and, by the same token, assume the "deficit" of relevant expertise on the part of citizens (cf. Wynne, 2007).

The technocratic epistemology thus facilitated the formation of the "nuclear safety myth" that disguised an inadequate level of nuclear emergency preparedness (RJIF, 2012: chs.8–9). For example, when AEC approved the construction of the first commercial nuclear reactors, including one at the Fukushima Daiichi, in 1966, it had no safety standards regarding earthquakes, tsunami, and other natural disasters (NAIIC, 2012b: ch.1). As recounted by Tajima Eizō (1995: 177) who had served on AEC and NSC in the 1970s, "at that time, we lacked clear criteria for approving the construction of nuclear reactors. And yet, we were asked to guarantee the 'safety' of construction plans." In fact, the organizational framework of Japan's nuclear safety was severely compromised by the government's pro-nuclear policy: NSC was defined as an advisory board with only five members; its secretariat staff was borrowed from pro-nuclear STA; its role was to rationalize, rather than regulate, the safety of nuclear reactors; and many regulatory functions remained dispersed across pro-nuclear organizations, such as AEC, STA, and the Ministry of International Trade and Industry (NHK ETV Tokushū Shuzaihan, 2013: 251–257). This situation of regulatory capture did not change even after the government created NISA as a regulatory agency proper in 2001, as extensively documented in the investigative reports by RJIF, IC, and NAIIC.

All the while, the nuclear safety myth persisted. For example, when the 1979 Three Mile Island accident prompted municipalities hosting nuclear reactors to request nuclear-emergency guidelines be created, the government initially resisted, arguing "because we strictly implement nuclear safety regulation, the probability of accidents like the one that happened in the United States is almost zero in Japan" (House of Councillors, 1979). Moreover, although NSC eventually created non-binding guidelines for nuclear emergency in June 1980, the government refused to update the guidelines after the 1986 Chernobyl disaster, insisting "our measures for accident management are perfect," "we have nothing to worry about," and "the existing system of nuclear safety by the government and electric power companies is already sufficient" (House of Representatives, 1986). The government finally created the Act on Special Measures Concerning Nuclear Emergency in December 1999, as the Tōkaimura nuclear accident earlier that year had killed two nuclear workers and exposed hundreds of local residents to the leaked radioactive materials (e-Gov, 1999). Nevertheless, NSC's guidelines (2010) for nuclear emergency remained non-binding and held municipalities as responsible for off-site evacuation planning without subjecting them to any approving mechanism, for NSC precluded the possibility of a severe accident releasing the amount of radioactivity that would require evacuation (Matsuno, 2007). Despite this inadequate level of nuclear emergency preparedness, more than 60 percent of the respondents in various opinion polls continued to accept the necessity of nuclear power from the 1990s through 2010 (Kitada, 2013).

I argue that such acquiescence on the part of citizens can be attributed, in no small part, to the dominance of the technocratic epistemology that authorized the developmental state to make policies on behalf of citizens based on its alleged epistemic superiority. Traditionally, most NGOs in Japan did not engage in policy advocacy but only helped implement government policies by mobilizing local populations (Ogawa, 2009) and, as the result, they were chronically short on experts capable of challenging government policies (Pekkanen, 2006). This subordination of the civil society persisted even after a severe economic recession in the 1990s undermined the legitimacy of the developmental state. This is not only because NGOs remained constrained by various legal and economic limits (Kawato et al., 2012) but also because the government continued to monopolize highly credentialed experts, weakening the capacity of the civil society to mobilize sufficient counter-expertise. In fact, the distribution of expertise was so asymmetrical that Takagi Jinzaburō (2014: ch.2), a founder of the most prominent antinuclear NGO in Japan "Citizens' Nuclear Information Center," once lamented that Japan had lacked university departments, research institutes, and other independent organizations capable of mobilizing "critical expertise" to effectively challenge the government in the policy domain of nuclear energy and safety. Thus, even when the opposition parties and concerned citizens continued to express their doubts about nuclear safety in the National Diet and through lawsuits in the 2000s, they were repeatedly assured by NSC and NISA that Japan's nuclear safety was supported by "the latest scientific and technological knowledge" in seismology, earthquake engineering, and other relevant fields (House of Councillors, 2008; House of Representatives, 2006).

In sum, the technocratic epistemology – entrenched in the developmental state and accepted by the majority of citizens – enabled the nuclear safety myth to persist while discrediting policy challenges from the minority of antinuclear politicians and citizens. In a way, the technocratic epistemology provided post hoc legitimation for prioritizing the promotion of nuclear power over the enforcement of nuclear safety: although the civilian use of nuclear energy could be dangerous as evinced by nuclear accidents in Chernobyl, Tōkaimura, and other places both inside and outside of Japan, nuclear safety was nonetheless guaranteed by the superior technical competencies of state bureaucrats and their expert advisers. This epistemic dimension of Japan's pro-nuclear policy thus completes the proposed macro-institutional explanation of the Fukushima nuclear disaster as a case of preparedness failure.

## 7. Discussion: The Fukushima nuclear disaster and its aftermath

As summarized in Figure 1, the foregoing analysis has illuminated the sociotechnical imaginary and civic epistemology – the two deepest layers of culture – of the postwar Japanese developmental state vis-à-vis their effects on the organizational framework of nuclear safety. This macro-institutional explanation injects more conceptual and empirical rigor into the political-economic and ethnocultural explanations of the preparedness failure. On the one hand, the pacifist imaginary and technocratic epistemology, as part and parcel of the developmental state, preceded the formation of the political economy of nuclear energy and continued to legitimate it, even though the nuclear village began to directly influence the organizational framework of nuclear safety once it was formed. On the other hand, it was not "Japanese culture" in general, but the imaginary and epistemic dimensions of the developmental state in particular, that enabled regulatory capture in nuclear safety to emerge and persist until the Fukushima nuclear disaster in March 2011.

Now, an important remaining question is whether and how the nuclear disaster affected the pacifist imaginary and technocratic epistemology of nuclear energy. Although this question falls outside the focus of this paper, it warrants a brief discussion given its

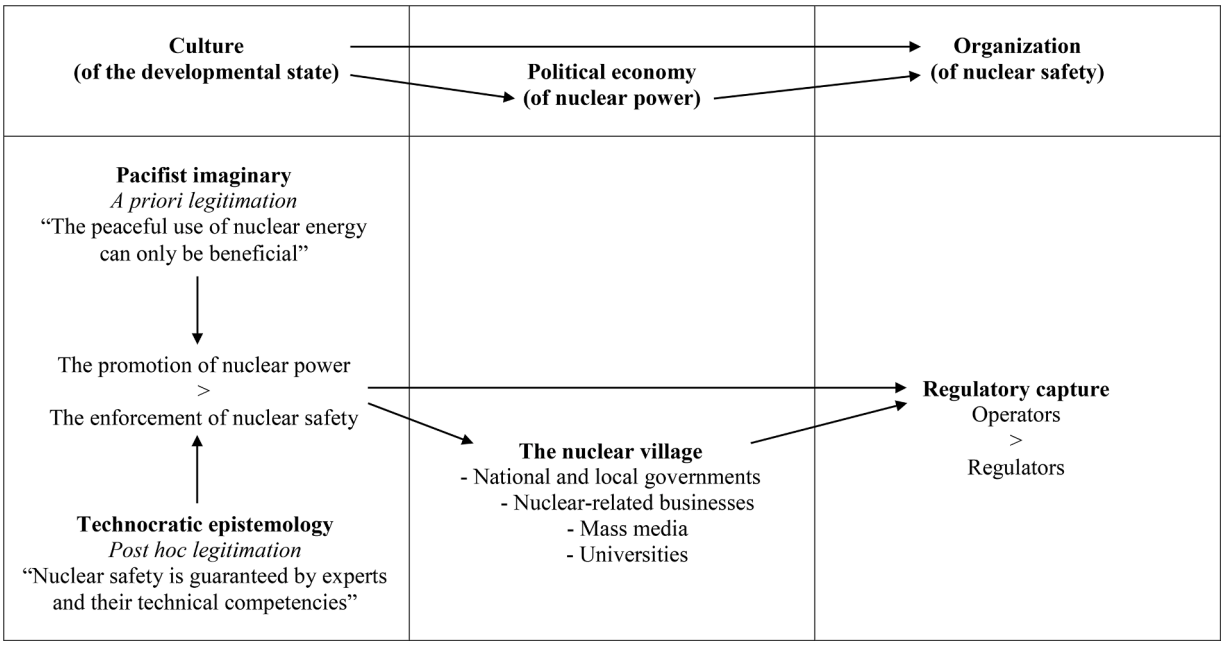


**Fig. 1.** The causal pathways of Japan's nuclear safety failure.

significance for nuclear emergency preparedness in Japan and beyond.

Simply put, the pacifist imaginary and technocratic epistemology remained prevalent within the government – and they were even reinforced in some ways – whereas they lost resonance among the majority of citizens. To begin with, while still deliberating on regulatory reform in May 2012, DPJ Prime Minister Noda Yoshihiko justified nuclear energy cooperation agreements with Vietnam, Jordan, and other countries as follows: "It's our country's important responsibility to share the experience and lessons of last year's nuclear disaster with the world and contribute to improving nuclear safety internationally. This is why it's meaningful to engage in nuclear cooperation by ensuring the non-proliferation and peaceful use of nuclear energy as well as offering very safe nuclear technology" (House of Representatives, 2012). Similarly, after the LDP-Kōmeitō coalition ousted the DPJ in December 2012, LDP Prime Minister Abe Shinzō insisted, "Our country has the responsibility to improve nuclear safety and contribute to the peaceful use of nuclear energy worldwide by sharing the insights and lessons from the severe accident" (House of Representatives, 2014). For the government, it was all the more important to embrace the pacifist imaginary and reaffirm "the peaceful use of nuclear energy" as Japan's national mission, to internationally share its nuclear technology that became safer precisely because of the nuclear disaster.

By contrast, the majority of citizens began to associate "nuclear energy" with "dangerous," "unreliable," "worrisome," and other negative images (Japan Atomic Energy Relations Organization, 2018) and hence opposed the restart of nuclear reactors (Agency for Natural Resources and Energy, 2018). Sure enough, when the DPJ government organized nationwide discussion in summer 2012 as part of deliberation on the new Basic Energy Plan, the majority of participants expressed their wish to make Japan nuclear-free by 2030 through public comments and hearings as well as various opinion surveys including the two-day deliberative polling (Asahi shinbun, 2012a). For these citizens, nuclear energy could be no longer imagined in positive terms because even its "peaceful use" proved harmful to the lives and livelihoods of people in Fukushima and adjacent prefectures.

Equally important, these citizens also began to question the technocratic epistemology. As citizens debated the future of Japan's energy policy, they were concerned not only about the substance of the post-Fukushima energy policy, e.g., whether or not nuclear power should be phased out, how renewable energy should be promoted, and how the electricity market should be reformed. They were also concerned about the very procedure of energy policymaking (Saito, 2021a); for example, e-shift (2011), one of the largest networks of antinuclear and environmental NGOs in Japan, criticized the closed nature of the existing procedure and demanded that energy policymaking be more transparent and open to the voices of ordinary citizens and suggestions from NGOs.

Pro-nuclear METI, however, resisted such criticism and demand from the civil society by downplaying the nationwide discussion as "populism" inappropriate for deliberation on "such an important policy issue" (quoted in Ōshika, 2013: 592). METI also pressed the DPJ to set up a new expert committee to "rationally accept the results of nationwide discussion" by taking into account "the limitations of the methods of public participation" (Asahi shinbun, 2012b). Moreover, after the LDP's return to power, the government organized only one round of public comments on the new Basic Energy Plan, stating that one round of public comments should be more than enough because "no law requires the government to consult with citizens on the Basic Energy Plan" (METI, 2014). In fact, the new Basic Energy Plan discounted the necessity of public participation in energy policymaking by describing citizens as passive audiences who needed to "deepen their understanding of the real situations concerning energy," on the one hand, and encouraging the government to use more effective "public relations" and "education" to help citizens "increase their trust in energy policy," on the other hand (Agency for Natural Resources and Energy, 2014). Thus, while more and more citizens began to question the technocratic epistemology by demanding greater public participation, the government defended it even more vigorously.

In sum, the Fukushima nuclear disaster significantly undermined the pacifist imaginary and technocratic epistemology, as the majority of citizens began to oppose the restart of nuclear reactors and demand public participation in energy policymaking. At the same time, however, the pacifist imaginary persisted among government officials who reaffirmed post-Fukushima Japan's national mission to promote the civilian use of nuclear energy worldwide, while the technocratic epistemology was reinvigorated by the LDP that had championed the postwar developmental state. Thus, even though the post-Fukushima regulatory reform focused on preventing regulatory capture in nuclear safety from happening again, the macro-institutional causes of the preparedness failure – the pacifist imaginary and technocratic epistemology – persisted in the government.

## 8. Conclusion and implications

In this paper, I have demonstrated how the two STS concepts – sociotechnical imaginary and civic epistemology – can help explain the Fukushima nuclear disaster as a case of preparedness failure within the historical context of the developmental state in postwar Japan. The first concept has illuminated how the pacifist imaginary enabled the emergence of Japan's pro-nuclear political economy by defining the civilian use of nuclear energy as beneficial for humanity and hence providing a priori legitimation for promoting nuclear power as a means of economic development. The second concept has also shed light on how the technocratic epistemology served as post hoc legitimation for the government to assume and assert that nuclear safety was guaranteed by the technical competencies of state bureaucrats and their expert advisors. This set of the peculiar imaginary and epistemology permitted regulatory capture to persist and result in the organizational failure of nuclear emergency preparedness in March 2011.

To conclude, I would like to suggest two lines of comparative inquiry to better understand the role of sociotechnical imaginary and civic epistemology in nuclear emergency preparedness. The first inquiry can begin by asking to what extent the pacifist imaginary and

technocratic epistemology are distinct to the Japanese developmental state. Because the developmental state is "both particular and generalizable" (Johnson, 1999: 43), it inevitably raises questions about similarities and differences between Japan and other developmental states (Onis, 1991), specifically, South Korea and Taiwan, the two East Asian developmental states with nuclear power plants. For example, South Korea's sociotechnical imaginary of nuclear energy was decidedly "developmental nationalist" (Jasanoff & Kim, 2009), and its civic epistemology was centered on the "political epistemic community" of experts (Lee, 2000). Likewise, Taiwan's sociotechnical imaginary was geared toward "economic growth" through industrialization (Hsu, 2005), and its civic epistemology was anchored in "authoritative expert politics" supported by technocrats and science elites (Chou, 2015). Then, what similarities and differences exist between the imaginaries and epistemologies of nuclear energy in Japan, South Korea, and Taiwan, and why?

In addition, the second inquiry can pursue temporal comparison by focusing on the evolution of sociotechnical imaginaries and civic epistemologies of nuclear energy vis-à-vis developmental states. Although I have characterized Japan as the developmental state for the duration of seventy years (1945–2015), the developmental state is neither monolithic nor constant. Especially since neoliberalism emerged as a global ideational force of policymaking in the 1990s, the developmental state has been reshaped by the evolving competition between networks of policymakers aligned differently with neoliberalism and developmentalism (Carroll & Jarvis, 2017; Haggard, 2018). Nevertheless, it is premature to declare "the death of the developmental state," whether due to neoliberal globalization or worldwide democratization; rather, the developmental states in Japan and elsewhere adapted to new challenges and opportunities both domestic and international (Chu, 2019; Esarey et al., 2020; Wade, 2018). Did this evolution of developmental states affect the imaginaries and epistemologies of nuclear energy, and if so, how and why?

These two lines of comparative inquiry are theoretically important because they help disaster researchers better understand the role of culture in nuclear emergency preparedness *at the national level*, for the nation-state remains the central actor in any disaster governance. Despite the global force of institutional isomorphism based on the universalistic characters of science and technology (Drori et al., 2002; Meyer, 2010), the imaginaries and epistemologies of science and technology policymaking vary across nation-states (Jasanoff, 2005; Jasanoff & Kim, 2015). In nuclear governance, too, different countries continue to have different laws and policies (International Atomic Energy Agency, 2021), even though global models and standards of nuclear safety have been constructed by international organizations, scientists, and engineers who believe that they can make nuclear technology safe and beneficial for humanity (Downer, 2014; Perrow, 2013). Here, the suggested comparative inquiries can illuminate what kinds of imaginaries and epistemologies exist in different countries and how they might create *nationally specific vulnerabilities* in nuclear emergency preparedness.

Precisely for this reason, these lines of inquiry are also practically important: they can help researchers, policymakers, and citizens identify and rectify those vulnerabilities so as to minimize potential losses caused by a nuclear disaster. To be sure, some might argue that such effort for improving nuclear emergency preparedness will simply produce more "fantasy documents" (Clarke, 1999) or "rituals of rationality" (Wynne, 2011) to deny the catastrophic risks of nuclear power that humanity can never sufficiently prepare for (Perrow, 1999, 2007). But, until nuclear power plants will disappear from the world, humanity can keep improving nuclear emergency preparedness *precisely because preparedness is socially constructed* in the quintessentially STS sense: "*because* something has been constructed and *well* constructed it is *thus* solid, durable, independent, autonomous and necessary" (Latour, 2003: 38; emphasis in original). Put another way, humans and nonhumans, as well as hard and soft infrastructures, can be reassembled to increase the level of nuclear emergency preparedness to better cope with historically unprecedented situations, such as increasing extreme weather events (cf. International Atomic Energy Agency, 2019).

To this end, critical reflections on the imaginaries and epistemologies of nuclear energy are crucial because they enable researchers, policymakers, and citizens to imagine alternative assemblages of nuclear emergency preparedness at the ontological level and recognize alternative "right" ways of constructing them at the epistemic level. Indeed, such reflections will have broader, important implications for disaster governance in today's world, especially how to prepare for the impending climate disaster, which may well require the radical reassembling of modernity itself.

## References

Agency for Natural Resources and Energy. (2010). Basic energy plan. http://www.enecho.meti.go.jp/category/others/basic_plan/pdf/100618honbun.pdf.
Agency for Natural Resources and Energy. (2014). Basic energy plan. http://www.enecho.meti.go.jp/category/others/basic_plan/pdf/140411.pdf.
Agency for Natural Resources and Energy. (2017). Trends in secondary energy sources. http://www.enecho.meti.go.jp/about/whitepaper/2017html/2-1-4.html.
Agency for Natural Resources and Energy. (2018). Dialogue and public relations. https://www.meti.go.jp/shingikai/enecho/denryoku_gas/genshiryoku/pdf/017_03_00.pdf.
Akimoto, K. (2014). *Genshiryokusuishinno gendaishi: genshiryokureimeikikara Fukushima genpatsujikomade*. Tokyo: Gendai Shokan.
Amano, I. (2009). *Daigakuno tanjō (Vol. 1)*. Tokyo: Chūō Kōron Sha.
Arima, T. (2012). *Genpatsuto genbaku: "Nichi-bei-ei" kakubusōno anyaku*. Tokyo: Bungei Shunjū.
Asahi shinbun. (1954, March 20). Monosugoi "genshiryoku" no hanashi: 4-patsude Nihonjū yakedo heiwaeno riyōkosodaiji.
Asahi shinbun. (2012a, August 23). "Genpatsu 0%" shijisaita.
Asahi shinbun. (2012b, August 24). "Genpatsuzero" shijiōinoni.
Atomic Energy Commission (AEC). 1956a. Statement of Mr. Matsutaro Shoriki, Minister of State, Chairman of the Atomic Energy Commission of Japan. http://www.aec.go.jp/jicst/NC/about/ugoki/geppou/V01/N01/19560501V01N01.HTML.
Atomic Energy Commission (AEC). 1956b. The long-term program for research, development and utilization of nuclear energy http://www.aec.go.jp/jicst/NC/about/hakusho/wp1956/ss1010401.htm.

Beck, U. (2009). *World at risk*. Cambridge: Polity.
Beck, U. (2016). *The metamorphosis of the world*. Cambridge: Polity Press.
Befu, H. (2001). *Hegemony of homogeneity: An anthropological analysis of "Nihonjinron"*. Tokyo: Trans Pacific Press.
Cabinet Office. (1969). Opinion poll regarding the peaceful use of nuclear energy. http://survey.gov-online.go.jp/s43/S44-03-43-21.html.
Callon, M., Lascoumes, P., & Barthe, Y. (2009). *Acting in an uncertain world: An essay on technical democracy*. Cambridge, MA: The MIT Press.
Carroll, T., & Jarvis, D. S. L. (2017). *Asia after the developmental state: Disembedding autonomy*. New York: Cambridge University Press.
Castells, M. (1992). Four Asian Tigers with a dragon head: A comparative analysis of the state, economy and society in the Asian Pacific Rim. In R. Appelbaum, & J. Henderson (Eds.), *States and development in the Asian Pacific Rim* (pp. 33–70). London: Sage Publications.
Castoriadis, C. (1987). *The imaginary institution of society*. Cambridge, MA: MIT Press.
Chou, K. T. (2015). From anti-pollution to climate change risk movement: Reshaping civic epistemology. *Sustainability, 7*(11), 14574–14596.
Chu, Y.-W. (2019). Democratization, globalization, and institutional adaptation: The developmental states of South Korea and Taiwan. *Review of International Political Economy*.
Clarke, L. (1999). *Mission improbable: Using fantasy documents to tame disaster*. Chicago: University of Chicago Press.
Clarke, L. (2005). *Worst cases: Terror and catastrophe in the popular imagination*. Chicago: University of Chicago Press.
Clarke, L., & Short, J. F., Jr. (1993). Social organization and risk: Some current controversies. *Annual Review of Sociology, 19*, 375–399.
Downer, J. (2014). Disowning Fukushima: Managing the credibility of nuclear reliability assessment in the wake of disaster. *Regulation & Governance, 8*(3), 287–309.
Drori, G. S., Meyer, J. W., Ramirez, F. O., & Schofer, E. (2002). *Science in the modern world polity: Institutionalization and globalization*. Stanford: Stanford University Press.
e-Gov. (1955). Atomic Energy Basic Act. http://law.e-gov.go.jp/htmldata/S30/S30HO186.html.
e-Gov. (1999). Act on Special Measures Concerning Nuclear Emergency Preparedness. http://law.e-gov.go.jp/htmldata/H11/H11HO156.html.
Esarey, A., Haddad, M. A., Lewis, J. I., & Harrell, S. (2020). In *Greening East Asia: The rise of the eco-developmental state*. Seatle: University of Washington Press.
e-shift. (2011). We want new energy policy to reflect public opinions. http://e-shift.org/?p=869.
Evans, P., & Rauch, J. E. (1999). Bureaucracy and growth: A cross-national analysis of the effects of "Weberian" state structures on economic growth. *American Sociological Review, 64*(5), 748–765.
Fischer, F. (1990). *Technocracy and the politics of expertise*. Newbury Park, CA: Sage Publications.
Flam, H. (1994). *States and anti-nuclear movements*. Edinburgh: Edinburgh University Press.
Foucault, M. (1980). *Power/knowledge: Selected interviews and other writings 1972-1977*. New York: Pantheon Books.
Funabashi, H., Hasegawa, K., & Ijima, N. (2012). *Kakunenryōshisetsuno shakaigaku: Aomori Rokkashomura*. Tokyo: Yuhikaku.
Gijutsuto ningen. (1978). *Genshiryokuto anzenseironsō: Ikatagenpatsusoshōno hanketsuhihan*. Tokyo: Gijutsuto ningen.
Haggard, S. (2018). *Developmental states*. New York: Cambridge University Press.
Hecht, G. (2009). *The radiance of France: Nuclear power and national identity after World War II*. Cambridge, MA: MIT Press.
Hiroshima City. (1982). *Hiroshima shinshi: shiryohen (Vol. 2)*. Hiroshima: Nakamoto honten.
House of Councillors. (1953, December 7). Budget Committee.
House of Councillors. (1953, April 5). Plenary Session.
House of Councillors. (1956, March 20). Cabinet Committee.
House of Councillors. (1959, March 24). Budget Committee Second Division.
House of Councillors. (1970, March 6). *Science and Technology Promotion Special Committee*.
House of Councillors. (1976, May 10). Plenary Session.
House of Councillors. (1978, June 7). Plenary Session.
House of Councillors. (1979, April 27). Plenary Session.
House of Councillors. (2008, April 23). Disaster Preparedness and Response Special Committee.
House of Representatives. (1954a, February 24). Cabinet Committee.
House of Representatives. (1954b, March 4). Plenary Session.
House of Representatives. (1956, March 10). *Science and Technology Promotion Special Committee*.
House of Representatives. (1958, February 13). *Science and Technology Promotion Special Committee*.
House of Representatives. (1974, May 22). Commerce and Industry Committee.
House of Representatives. (1978, April 13). *Science and Technology Promotion Special Committee*.
House of Representatives. (1986, May 2). Science and Technology Promotion Special Committee.
House of Representatives. (2006, March 31). *Economic and Industrial Committee*.
House of Representatives. (2012, May 29). Plenary Session.
House of Representatives. (2014, January 28). Plenary Session.
Hsu, S.-H. (2005). Advocacy coalitions and policy change on nuclear power utilization in Taiwan. *The Social Science Journal, 42*(2), 215–229.
Iio, J. (2007). *Nihonno touchikōzou*. Tokyo: Chūō Kōron Shinsha.
Ikeuchi, S. (2016). *Kagakushato sensō*. Tokyo: Iwanami Shoten.
Inoki, T. (2013). *Nihonno kindai (Vol. 7): keizaisenchōno kajitsu 1955–1972*. Tokyo: Chuokoron-shinsha.
International Atomic Energy Agency (IAEA). (2021). Country nuclear power profiles. https://www.iaea.org/resources/databases/country-nuclear-power-profiles.
International Atomic Energy Agency (IAEA). (2019). *Adapting the energy sector to climate change*. Vienna: IAEA.
Itoi Laboratory. (2012). Fukushima Daiichi Genshiryokuhatsudenshojiko hkokusho matome. http://park.itc.u-tokyo.ac.jp/tkdlab/fukushimanpp/index.html.
Japan Atomic Energy Agency. (2006). The plan for developing the nation through nuclear energy. https://atomica.jaea.go.jp/data/detail/dat_detail_10-02-02-15.html.
Japan Atomic Energy Relations Organization. (2010). A national poll on nuclear energy 2010. https://www.jaero.or.jp/data/01jigyou/tyousakenkyu22.html.
Japan Atomic Energy Relations Organization. (2018). A national poll on nuclear energy 2015. https://www.jaero.or.jp/data/01jigyou/survey_pickup.html.
Jasanoff, S. (2004). In *States of knowledge: The co-production of science and the social order*. New York: Routledge.
Jasanoff, S. (2005). *Designs on nature: Science and democracy in Europe and the United States*. Princeton: Princeton University Press.
Japan Atomic Industrial Forum. (1959). *Shinpan genshiryokudokuhon*. Tokyo: Japan Atomic Industrial Forum.
Jasanoff, S., & Kim, S.-H. (2009). Containing the atom: Sociotechnical imaginaries and nuclear power in the United States and South Korea. *Minerva, 47*(2), 119–146.
Jasanoff, S., & Kim, S.-H. (2015). *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*. Chicago: University of Chicago Press.
Jasper, J. M. (1990). *Nuclear politics: Energy and the state in the United States, Sweden, and France*. Princeton: Princeton University Press.
Johnson, C. (1982). *MITI and the Japanese miracle: The growth of industrial policy: 1925–1975*. Stanford: Stanford University Press.
Johnson, C. (1999). The Developmental state: Odyssey of a concept. In M. Woo-Cumings (Ed.), *The Developmental State* (pp. 32–60). Ithaca: Cornell University Press.
Kaido, Y. (2011). *Genpatsusoshō*. Tokyo: Iwanami Shoten.
Kawato, Y., Pekkanen, R., & Tsujinaka, Y. (2012). Civil society and the triple disasters: Revealed strengths and weaknesses. In J. Kingston (Ed.), *Natural disaster and nuclear crisis in Japan: Response and recovery after Japan's 3/11* (pp. 78–93). London: Routledge.

Kitada, A. (2013). Public opinion on nuclear power generation measured in continuous polls changes after Fukushima Daiichi Nuclear Power Plant Accident over the past 30 years. *Journal of Atomic Energy Society of Japan, 12*(3), 177–196.
Klinenberg, E. (2015). *Heat wave: A social autopsy of disaster in Chicago (2nd ed.)*. Chicago: University of Chicago Press.
Komatsu, K. (2012). *Genpatsunishigamitsuku hitobitono mure: genpatsuriekikyōdoutaino himitsuni semaru*. Tokyo: Shin Nihon Shuppansha.
Kurokawa, K. (2016). *Kiseino toriko: gurupushinkuga Nihonwo horobosu*. Tokyo: Kōdansha.
Latour, B. (1999). *Pandora's hope: Essays on the reality of science studies*. Cambridge, MA: Harvard University Press.
Latour, B. (2003). The promises of constructivism. In D. Ihde Don, & E. Selinger (Eds.), *Chasing technoscience: Matrix for materiality* (pp. 27–46). Bloomington: Indiana University Press. edited by.
Lee, T. (2020). From nuclear energy developmental state to energy transition in South Korea: The role of the political epistemic community. *Environmental Policy and Governance*.
Matsuno, G. (2007). *Genshiryokubousai: genshiryokurisukusubeteto tadashikumukiautameno*. Tokyo: Soueisha.
Meyer, J. W. (2010). World society, institutional theories, and the actor. *Annual Review of Sociology, 36*, 1–20.
Miller, C. A. (2008). Civic epistemologies: Constituting knowledge and order in political communities. *Sociology Compass, 2*(6), 1896–1919.
Ministry of Economy, Trade and Industry (METI). (2014, February 25). Public comments on the new basic energy plan: results. http://www.enecho.meti.go.jp/category/others/basic_plan/pdf/140225_2.pdf.
Ministry of Education. (1946). *Shinkyōikushishin (Vol. 1)*. Tokyo: Ministry of Education.
Ministry of Education. (1972). *Gakusei hyakunenshi*. Tokyo: Teikoku Chihōgyōsei Gakkai.
Investigation Committee of the Cabinet Office (IC). (2012). Final investigation report. Retrieved from December 19, 2019, from http://icanps.go.jp/post-2.html.
Matsuyama District Court. (1978). The judgment on the request to cancel the permission for the Ikata Nuclear Power Plant. https://www.courts.go.jp/app/files/hanrei_jp/694/017694_hanrei.pdf.
Ministry of Foreign Affairs. (2010, November 29). "Kaku wo motometa Nihon" houdōnioite toriagerareta bunshotōnikansuru Gaimushō chōsahoukokusho. https://www.mofa.go.jp/mofaj/gaiko/kaku_hokoku/pdfs/kaku_hokoku00.pdf.
Mizuno, H. (2008). *Science for the empire: Scientific nationalism in modern Japan*. Stanford: Stanford University Press.
Niigata, N. (2014). *Nihonjinwa nazekangaeyouto shinainoka: Fukushima genpatsujikoto Nihonbunka*. Tokyo: Shinyōsha.
Morgan, K. J., & Orloff, A. S. (2017). In *The many hands of the state: Theorizing political authority and social control*. Cambridge: Cambridge University Press.
Nakayama, S. (1978). *Teikokudaigakuno tanjō: kokusaihikakuno nakadeno Tōdai*. Tokyo: Chūō Kōron Sha.
National Diet Independent Investigation Commission on the Fukushima Nuclear Accident (NAIIC). (2012a). Executive summary global edition. http://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naiic.go.jp/en/report/index.html.
National Diet Independent Investigation Commission on the Fukushima Nuclear Accident (NAIIC). (2012b). Hōkokusho. http://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naiic.go.jp/index.html.
NHK ETV Tokushū Shuzaihan. (2013). *Genpatsumerutodauneno michi: genshiryokuseisaku kenkyūkai 100jikanno shōgen*. Tokyo: Shinchosha.
Nuclear Safety Commission (NSC). (2010). On nuclear emergency preparedness and response. http://www.polan.tokyo.jp/05_1f/pdf/04_59-15.pdf.
Ogawa, A. (2009). *The failure of civil society? The third sector and the state in contemporary Japan*. Albany: State University of New York Press.
Onis, Z. (1991). The logic of the developmental state. *Comparative Politics, 24*(1), 109–126.
Ōshika, Y. (2013). *Merutodaun: documento Fukushima Daiichi genpatsujiko*. Tokyo: Kodansha.
Ōta, M. (2014). *Nichibei "kaku" doumei: genbaku, kakunokasa*. Fukushima. Tokyo: Iwanami Shoten.
Pekkanen, R. (2006). *Japan's dual civil society: Members without advocates*. Stanford: Stanford University Press.
Perrow, C. (1999). *Normal accidents: Living with high-risk technologies (Updated ed.)*. Princeton: Princeton University Press.
Perrow, C. (2007). *The next catastrophe: Reducing our vulnerabilities to natural, industrial, and terrorist disasters*. Princeton: Princeton University Press.
Perrow, C. (2013). Nuclear denial: From Hiroshima to Fukushima. *Bulletin of the Atomic Scientist, 69*(5), 56–67.
Perry, R. W., Lindell, M. K., & Tierney, K. J. (2001). *Facing the unexpected: Disaster preparedness and response in the United States*. Washington, D.C: Joseph Henry Press.
Pidgeon, N., & O'Leary, M. (2000). Man-made disasters: Why technology and organizations (sometimes) fail. *Safety Science, 34*, 15–30.
Rebuild Japan Initiative Foundation (RJIF). (2012). *Fukushima genpatsujiko dokuritsukenshō iinkai chōsakenshō hōkokusho*. Tokyo: Rebuild Japan Initiative Foundation.
Rodríguez, H., Donner, W., & Trainor, J. E. (2018). In *Handbook of disaster research (2nd ed.)*. Cham: Springer.
Rodríguez, H., Quarantelli, E. L., & Dynes, R. R. (2007). In *Handbook of disaster research*. New York: Springer.
Saito, H., & Pahk, S.-H. (2016). The realpolitik of nuclear risk: When political expediency trumps technical democracy. *Science, Technology and Society, 21*(1), 5–23.
Saito, Hiro. (2021a). The developmental state and public participation: The case of energy policy-making in Post-Fukushima Japan. *Science, Technology, & Human Values, 46*(1), 139–165.
Saito, Hiro. 2021b. The sacred and profane of Japan's nuclear safety myth: On the cultural logic of framing and overflowing. Cultural Sociology.
Shindo, M. (2012). *Seijishudō: kanryōseiwo toinaosu*. Tokyo: Chikuma Chobō.
Shibata, T., & Tomokiyo, H. (1999). *Genpatsu kokuminyoron: yoronchōsanimiru genshiryokuishikino hensen*. Tokyo: ERC Shuppan.
Steinmetz, G. (1999). In *State/culture: State-formation after the cultural turn*. Ithaca: Cornell University Press.
Supreme Court of Japan. (1992). The judgment on the request to cancel the permission for the Ikata Nuclear Power Plant. http://www.courts.go.jp/app/files/hanrei_jp/276/054276_hanrei.pdf.
Tajima, E. (1995). *Arubutsurigakushano shōgai*. Tokyo: Shinjinbutsu Ouraisha.
Takagi, J. (2014). *Shiminno kagaku*. Tokyo: Kōdansha.
Takeda, Y. (2018). *Nihonno genshiryokugaikō: shigenshōkoku 70-nenno kutō*. Tokyo: Chuokoron-Shinsha.
Tanaka, K. (2006). *Iwanamikōza "teikoku" Nihonno gakuchi (Vol. 7): jitsugakutoshiteno kagakugijutsu*. Tokyo: Iwanami Shoten.
Taylor, C. (2004). *Modern social imaginaries*. Durham: Duke University Press.
Thurbon, E. (2016). *Developmental mindset: The revival of financial activism in South Korea*. Ithaca: Cornell University Press.
Tierney, K. J. (2007). From the margins to the mainstream? Disaster research at the crossroads. *Annual Review of Sociology, 33*, 503–525.
Tierney, K. J. (2012). Disaster governance: Social, political, and economic dimensions. *Annual Review of Environment and Resources, 37*, 341–363.
Tierney, K. J. (2014). *The social roots of risk: Producing disasters, promoting resilience*. Stanford: Stanford University Press.
Tierney, K. J. (2019). *Disasters: A sociological approach*. Cambridge: Polity.
Turner, B. A., & Pidgeon, N. F. (1997). *Man-made disasters (2nd ed.)*. London: Butterworth-Heinemann.
Vaughan, D. (1996). *The Challenger launch decision: Risky technology, culture, and deviance at NASA*. Chicago: University Chicago Press.
Vaughan, D. (1999). The dark side of organizations: mistake, misconduct, and disaster. *Annual Review of Sociology, 25*, 271–305.
Wade, R. H. (2018). The developmental state: dead or alive? *Development and Change, 49*(2), 518–546.
Weart, S. R. (2012). *The rise of nuclear fear*. Cambridge, MA: Harvard University Press.
Woo, J. J. (2018). *The evolution of the Asian developmental state: Hong Kong and Singapore*. London: Routledge.
Woo-Cumings, M. (1999). In *The developmental state*. Ithaca: Cornell University Press.
Wynne, B. (2007). Public participation in science and technology: Performing and obscuring a political-conceptual category mistake. *East Asian Science, Technology and Society, 1*(1), 99–110.
Wynne, B. (2011). *Rationality and ritual: Participation and exclusion in nuclear decision-making*. New York: Routledge.
Yamamoto, A. (2012). *Kakuenerugīgensetsuno sengoshi 1945–1960: "hibakuno kioku" to "genshiryokuno yume"*. Kyoto: Jinbun Shoin.
Yamamoto, A. (2015). *Kakuto Nihonjin*. Tokyo: Chūō Kōron Sha.
Yasutomi, A. (2012). *Tōdaiwahōto genpatsukiki: bōkanshano ronri gimanno gengo*. Tokyo: Akashi Shoten.
Yomiuri shinbun. (1954, March 21). Morumottoniwa naritakunai genshiryokuwo heiwani.
Yomiuri shinbun. (1955, December 2). Sankashano koewo kiku: honsha ankēto.

Yoshimi, S. (2012). *Yumeno genshiryoku: Atoms for dream*. Tokyo: Chikuma Shobō.
Yoshino, K. (1992). *Cultural nationalism in contemporary Japan: A sociological enquiry*. London: Routledge.
Yoshioka, H. (2011). *Genshiryokuno shakaishi: sono Nihontekitenkai*. Tokyo: Asahi Shinbun Shuppan.

**Hiro Saito** is Assistant Professor of Sociology at Singapore Management University. Broadly interested in intersections between power and knowledge, he studies how interactions between government, experts, and citizens shape public policy. He is the author of *The History Problem: The Politics of War Commemoration in East Asia* and currently working on his second book *The Horizon of Democracy: Fukushima and Okinawa as Method*.