

FORUM REPORT 012

Recovering from Disaster

Reexamining Japan in Global Context Forum, Sendai, Japan, October 7, 2017

Reconstruction after the Great East Japan Earthquake

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The March 2011 earthquake and resulting tsunami ('3/11') were devastating for Japan. It is difficult, if not impossible, to separate the professional analysis of a political scientist from the personal experience of national tragedy in the face of a disaster such as 3/11. Nonetheless, it is essential to analyze the reconstruction efforts, for there is much to be learned. Visualizing the disaster requires taking into account multiple perspectives—both a bird's eye view, and one that is closer to the ground.

The affected areas can be classed into four categories. Places such as Kesenuma and Ishinomaki that were home to a large population and endured the largest tsunami waves saw severe damage. With huge amounts of rubble from destroyed buildings, reconstruction has been slow and difficult. The immense scale of the reconstruction effort has resulted in disparities in rebuilding citizens' lives.

Areas with smaller populations that were also hit by the

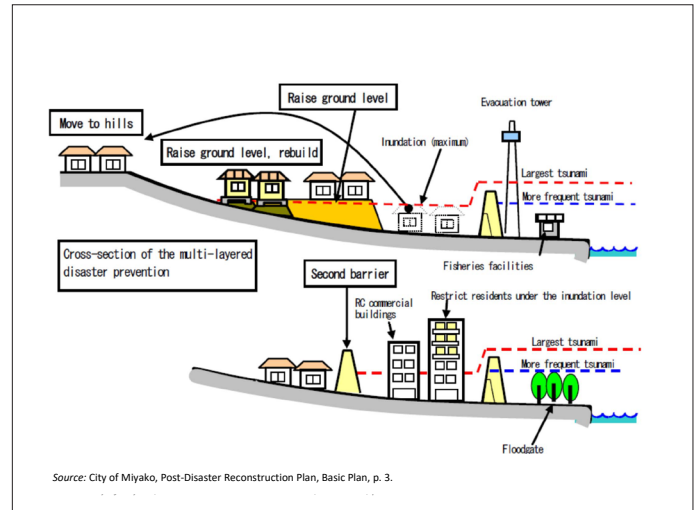
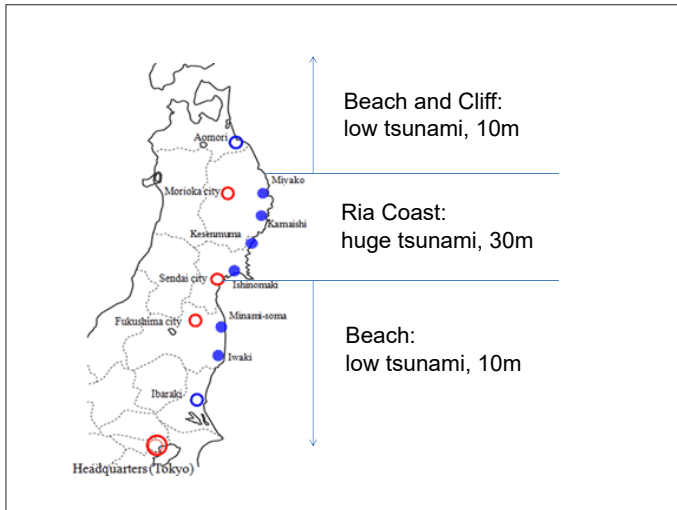
largest waves, such as Minamisanriku and Rikuzentakata, have needed total reconstruction, which has been challenging as well. There has been great difficulty in building new public housing, for example, because of the proximity of the mountains to the coastline.

Areas such as Sendai and Natori, home to a large population but spared the largest tsunami waves, have been comparatively 'easy' to rebuild. They have benefitted from a wide hinterland in which to rebuild housing.

Similarly, in areas such as south Sendai, where the population and tsunami waves were both relatively low, the wide hinterland has aided reconstruction efforts. In north Iwate, however, the mountains have made housing reconstruction difficult. In these smaller areas, mayors have led the efforts to rebuild.

Post-disaster reconstruction involves activity at multiple levels of society. Local communities have tried to foster the





Source: City of Miyako, Post-Disaster Reconstruction Plan, Basic Plan, p. 3.

rebirth of their neighbourhoods through cooperation with government entities, including through city and prefectural planning. The national government has supported emergency rescue efforts by the Self-Defense Forces (SDF). Although the activity of the SDF was highly appreciated in the damaged area, the SDF in some cases had difficulty recovering victims' bodies. The police were often more helpful in this sensitive task, since they had more experience dealing with fatalities. The national government also helped by planning the national reconstruction policy. The international community also played a role, conducting 'disaster diplomacy.' U.S. armed forces, for example, played a major role through Operation Tomodachi.

Following 3/11, the government set up a five-year conceptual plan for reconstruction. It involved three rebuilding phases: recovery concept development, planning, and implementation. Three key principles would guide the national government's efforts: The plan would account for the primacy of local government; entail a two-level approach, accounting for structural and non-structural factors; and would account for different local needs and geographical features. For example, in some areas, multiple physical barriers, such as raised ground, would separate residential areas from the coast. The rebuilding plans were meant to protect against not only average tsunamis (once in a decade or century), but also against large tsunamis (once in a century or millennium).

The government created a recovery agency to administer reconstruction efforts and negotiate with local and prefectural governments. However, interviews indicate that most local leaders tended to negotiate directly with industry. They also needed to cooperate. For example, it was important for the local government to get professionals in for land rezoning and rubble clearing. Small local governments do not usually need rezoning experts. As a result, they asked other local governments to send officials.

It is difficult not only to relocate people to safer areas, but also to rebuild true communities. Many communities have a distinct, organic way of life that is hard to recreate, especially

when many people died or moved away. Many people simply moved to other cities, but some smaller fishing villages have been able to maintain their communities.

In Kesennuma, residents were relocated from low to high areas, but it was not easy for the local government to find flat areas for public housing in the hillside. In Miyako, by 2017, residents had been moved into housing that is both at a high elevation and far from the sea. However, many locals are fisherfolk, for whom this relocation has been difficult.

Given the scale of destruction, it is astonishing that most industries have recovered after five years. Road access is still suspended in some areas, while in other areas roads are still under construction. Some cities have responded by networking with others to encourage volunteers and citizens to visit different areas to support reconstruction.

Although many commentators assert that Japanese society and politics remain unchanged, this is not necessarily the case. Six years following the disaster, some changes are evident. For example, we can examine 3/11's effect on politics, institutions, and social change. There is precedent for earthquakes having political effects. After the 1923 Kanto earthquake, Tokyo was in chaos. Such chaotic situations can make people more fanatical. A young man tried and failed to shoot Prince Hirohito, which ultimately led to the general resignation of the cabinet. The next cabinet, in 1924, was politically fragile, with members drawn not from parties but from bureaucratic stations. These leaders were crushed in the next general election, issuing in the era of political parties and democratizing Japanese politics.

The SDF and civil service have received reputational benefits for their role in the reconstruction efforts. There has also been higher support for the 'old' Liberal Democratic Party (LDP) of the first Shinzo Abe administration in 2012. An important task for political scientists is to distinguish change caused by 3/11 from pre-existing, 'background' political trends.

Institutionally, 3/11 has affected archives. In April 2011, a public record law was enacted to help preserve as many pub-

lic records as possible, and many volunteers and archivists helped damaged local governments to recover documents.

3/11 has also had effects on social bonds, kinship, and community. The marriage rate increased following the disaster, although this boom may have now ended. There is also an increased societal expectation of future big earthquakes in Western Japan, and an increase in anti-nuclear sentiment, evidenced by, for example, frequent anti-radiation demonstrations in Tokyo.



The first commenter asked two questions. First, they observed that there are big reconstruction projects all along the coastline in areas affected the disaster. Politically, this is understandable. However, given that the earthquake released so much stored tectonic energy, would it not make more sense to invest in preventative efforts in those areas of the country that are most vulnerable to new earthquakes? Second, the commenter pointed out that some communities were already depopulating as they aged before 3/11. Many residents have relocated and may not return, irrespective of reconstruction efforts. Is it better to evacuate cities that we expect to depopulate, or risk overspending on reconstruction? Relatedly, small local governments have very limited human resources to cope with reconstruction. Will some local communities simply disappear a result of the earthquake?

Prof. Makihara acknowledged that the reconstruction process may have been driven by politics more than by economics. However, while depopulation is a real phenomenon, many of the damaged areas had strong community ties, which have encouraged residents to remain, return, and rebuild. If not for these ties, it is possible that more residents would have moved away permanently. Given these strong bonds, the government had no option other than to reconstruct.

Another commenter asked about the political impacts of 3/11. What happens to political consolidation after a disaster? One might imagine a crisis either weakening or strengthening a government, as seems to have happened in this case. This seems like a rich area for comparative study. Initial conditions are of course important, but what role does the scale of the disaster play? Is there some threshold beyond which political consolidation or disintegration is more likely? What accounts, for example, for the different reactions to the 1923 Great Kanto Earthquake, which produced political chaos, and the Great East Japan Earthquake, which led to greater political consolidation?

Prof. Makihara replied that one major difference might be that 10% of Tokyo residents moved away after the Kanto earthquake.

The next commenter asked about the role of the reconstruction planning conference. They were expected to have plans and ideas, but local governments also had their own demands, and there were tensions between the two levels of

government. Japanese society and media largely supported local initiatives, which led to some over-construction.

Prof. Makihara responded that the reconstruction planning conference was chaotic. The reconstruction plan was discussed among very few members of the council. The government was concerned with national planning, such as choosing levee locations, not structural planning, which meant it could save money.

As a member of the reconstruction committee in Sendai City, Prof. Makihara observed that there was heavy demand from victims to have local officers involved. The main task of the local government is to account for citizens' opinions when making plans, mostly around rezoning. The distribution of tasks between local and national levels of government varies with the city, but in general the national government could not formulate such plans in detail and had to leave a lot up to the local governments. There was some overspending, but it could have been much worse.

The next commenter pointed out that the entire world has been very impressed with Japan's response to physical damage. Haiti, for example, was hit by a much less powerful earthquake in 2010, and has not made much progress rebuilding. Yet 3/11 was not just physically damaging, it was also psychologically traumatic. Japan still stigmatizes mental health issues. Has the psychological trauma of 3/11 been accounted for in any part of the recovery process? If so, who took the lead on this, and how effective have any efforts been? Has there been any wider effect on the stigma in Japan regarding mental health issues?

Prof. Makihara replied that this is a neglected aspect of many recovery-oriented discussions. People's psychological responses to 3/11 have been complex. Despite their deep grief, many people thank God or destiny for their survival. Many also struggle with survivor's guilt. Mental illness did tend to increase after 3/11 for a variety of reasons, including the initial shock, aftershocks, and social dislocation. People who moved into emergency housing, for example, often found it small, noisy, and uncomfortable. While such housing was intended to be temporary, some people have lived there for more than five years. Local doctors, nurses, and counsellors visited emergency housing units to counsel victims, but some isolated themselves and did not go outside, so it was difficult to meet them. International medical teams were also tasked with responding to the mental health impacts of the disaster (there is a World Health Organization report on their activities). The supply of these counselling services varied by prefecture, however. People who lost family members mostly had to rely on the community for support. Also, while the SDF worked very hard to retrieve victims' bodies, many members suffered psychologically as a result. This led to the introduction of more organized efforts to help them, such as counselling services. Overall, there may have been some small impact on the level of stigma around mental



health issues in Japan.

The next commenter recounted a personal anecdote about feeling torn, following 3/11, about whether to follow through with a planned party, which would bring much-needed economic benefits to the local community, or cancelling it out of respect for the victims. Cultural norms and values thus seem to play a complex role in recovery efforts. What are some of the downsides of culture in recovery, especially in Tohoku where people have a strong attachment to their land?

Prof. Makihara responded that this is a difficult question to answer. Many people say that after the 1995 Hanshin Earthquake, evacuation centres in Kansai were noisy, while Tohoku centres were silent, but it is not clear what accounts for such regional differences. One cultural challenge is that many Japanese are reluctant to express their feelings and needs directly. This can be a barrier to identifying problems and providing services.

The next commenter asked if there were any significant differences between Fukushima and other areas of Tohoku in terms of community ties, the reconstruction process, etc.?

Prof. Makihara responded that Fukushima is quite different, partly because of radiation, but also partly because the town hall in the prefectural centre was severely damaged, unlike in Miyagi or Iwate, further north. Civil servants, journalists, and bankers all had headquarters in Fukushima City, the prefectural capital. Their families could evacuate, but working people could not. The situation was very severe. The Fukushima government chose not to relocate its prefectural centre to Aizu-Wakamatsu, which lies about an hour and a half to the southwest.

The next question was about changing politics. The commenter pointed out that the Democratic Party of Japan took power in 2009 by emphasizing political initiatives. Are there any major differences in the communication strategies, attitudes, and so on of the two governments in terms of the reconstruction process?

Prof. Makihara responded that it depends on the minister. The Minister of Agriculture, who is from Yamagata, moved

very quickly and smoothly to send civil servants to affected areas. Things were very chaotic after the earthquake, but some ministers cooperated very quickly.

The next commenter noted that whether or not the local leadership had to evacuate strongly affects politics and policy-making when it comes to reconstruction efforts. There is also a certain tension between local and central governments; in the case of Hamadori's reconstruction, for example, although the central government respects local plans, those local plans and policies depend on the central government's investment, the Tokyo Electric Power Company's (TEPCO's) efforts at stabilizing the Fukushima Daiichi nuclear power station, and so on. There is a very complex relationship between local and central government planning and implementation. Population displacement has also meant that communities have had to deal with integrating new members.

Prof. Makihara responded by pointing out that reconstruction has not been an even process. Iwate and Miyagi, for example, saw much faster reconstruction relative to other areas. In the past 3-5 years: almost two thirds of their area has recovered. Conversely, in the case of Fukushima, reconstruction is now only about halfway done, and only one third of the people have been able to return.

Next, a commenter asked about memorialization. Are there any museums dedicated to 3/11, or plans to make any?

Prof. Makihara replied that each local city has its own memorial, whether a park, a museum, or a building. Shinchimi, in northern Fukushima, has a rescue building. One floor is a memorial floor showing photos, the height of the tsunami, etc. Many local governments have their own small museums such as this. In Sendai's case, the Miyagi prefectural library and the Sendai museum both have dedicated rooms. There are also plans for 'soft' memorializations, such as guided tours to the coastline. However, even in Sendai, there are no current plans to build a big museum, for two reasons: the high cost of building and maintaining one, and deference to the mental anguish of survivors who simply do not want to remember what happened.

Human and Institutional Challenges to Disaster Recovery

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Small Pacific nations are notably vulnerable to natural hazards. Japan is among the most exposed countries, but its resilience to disaster is much greater than that of many of its neighbours. Over the centuries, the country has developed an advanced disaster risk management system composed of laws, policies, regulations, and decision-making processes, as well as a strong culture of prevention and preparedness that influences community and individual behaviours.

The 1995 Hanshin earthquake, measured at a magnitude of 6.9 on the Richter scale, stimulated a paradigm shift in terms of disaster planning and management. Affected residents realized that they might not always be able to depend on their local governments for immediate rescue and relief, and quickly recognized the importance of preparing their own plans to cope with future disasters. Disaster planning came to emphasize community self-reliance (*kyojo*) and individual self-reliance (*jijo*), encouraging ordinary citizens to ‘be the help before the help arrives,’ as it was put by William Long of the U.S. Federal Emergency Management Agency (FEMA).

The 2011 Great East Japan Earthquake and the tsunami it triggered caused untold human suffering, including 15,894 deaths, 2,558 missing persons, and numerous injured and displaced persons. The tsunami also led to a severe nuclear accident at the Fukushima Daiichi Nuclear Power Station operated by TEPCO. The accident was rated a 7 (‘major accident’) on the International Atomic Energy Agency’s (IAEA’s) International Nuclear and Radiological Event Scale, a rating on par with the 1986 accident in Chernobyl. This ‘triple disaster’ of earthquake, tsunami, and nuclear meltdown had direct economic costs of approximately 16.9 trillion yen (U.S. \$199 billion). The total economic cost has yet to be tallied.

The main shock of the earthquake caused limited damage to buildings, since they were designed and constructed according to the current building code. Similarly, all of the high-speed trains operating on the Tohoku Shinkansen line stopped safely and performed as designed.

The tsunami that accompanied the earthquake is estimated to have been responsible for more than 90 percent of the deaths and missing persons. Many physical structures along the coast held up and were able to function. However, many others suffered unprecedented damage, with structures collapsing along approximately 190 km of the 300 km coast. In some places, the built environment slowed the tsunami, buy-

ing precious time for residents to evacuate. However, it was nevertheless made clear that communities cannot over-rely on physical structures, especially in the face of 40 m waves. This only reinforces the importance of disaster education.

The so-called ‘Miracle of Kamaishi’ offers a striking example of how such education can save lives. Kamaishi, a coastal town in Iwate prefecture, had been running a disaster prevention education program at their schools for a number of years under the guidance of Gunma University’s Professor Toshitaka Katada. The program, which included tsunami drills, taught students three principles of tsunami evacuation:

1. Do not believe in outdated assumptions. Hazard maps are based on past tsunamis.
2. Do your best and never give up hope of surviving.
3. Take the initiative to evacuate.

Professor Katada’s program was remarkably successful: 2,921 out of 2,926 elementary and junior high school students survived, with older students helping the younger ones to evacuate. The remaining five were not at school when the earthquake hit. Kamaishi’s non-survival rate was 1,180 persons (most of them adults) out of a total of 40,000, or approximately 2.9 percent.

Tsunami *tendenko*, or the mindset of ‘everyone for him- or herself,’ is a survival strategy that originated in the Sanriku region of northeastern Japan. It calls for placing one’s own survival above all else. According to *tendenko*, evacuees should concentrate on evacuating from their own life-threatening situation first and then rescue others using prepositioned equipment. In the context of a tsunami, this means evacuating quickly without waiting for anyone else; if individuals wait and look for their loved ones, then sometimes whole families can be swept away by the tsunami. However, not everyone is capable of practicing *tendenko*. In especially critical situations, like subway flooding, rescue attempts among evacuees often have tragic consequences.

The tragedy of Okawa Elementary School in Ishinomaki, Miyagi, stands in dark contrast to the ‘Miracle of Kamaishi.’ Staff from the school had divided opinions about what to do, and their indecisiveness resulted in the worst possible outcome. The only teacher who survived brought a few students up the side of the steep hill behind the school; the rest walked over to a nearby bridge, believing it to be safe, and were consequently all swept away. Out of 108 students and



3 were operating at full power, Unit 4 was out of operation, with its fuel having been moved to the spent fuel pool, and Units 5 and 6 were in inspection outages, with fuel still in their cores. When the earthquake struck, the station lost its offsite AC power, causing the generators to start up. The tsunami overwhelmed the station fifty minutes later. The ground was approximately 10 metres above sea level, and the sea wall was 5.7 metres high; the tsunami, by comparison, was estimated to have measured 13 to 15 metres in height. Areas around Units 1 to 4 were inundated with seawater, which damaged pumps, electrical distribution panels, back-up batteries, and diesel generators, and caused a station-wide blackout.

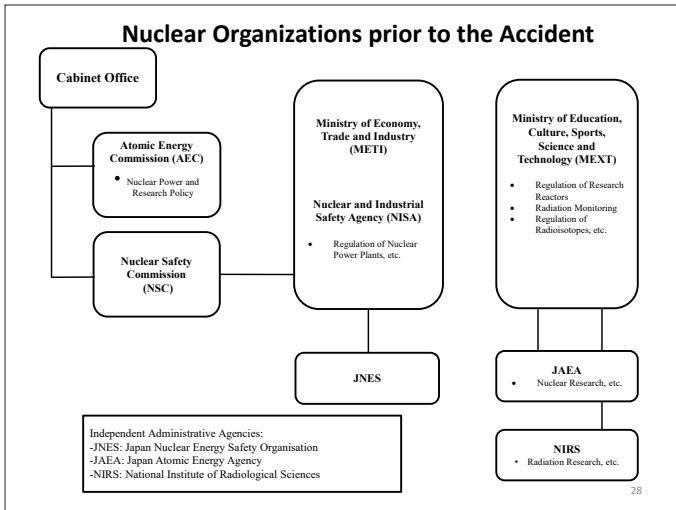
The plant had thirteen backup generators, three of which had been installed slightly higher than the rest. Those three backup generators worked, but the electrical distribution panels that controlled them were in the flooded basement, rendering them completely unusable. The generator at Unit 6 also worked, allowing Units 5 and 6 to remain stable; the problem was Units 1 to 4. Within 72 hours of the power loss, the reactor cores of Units 1, 2, and 3 had melted down, releasing hydrogen and radioactive materials. Hydrogen explosions in the reactor buildings of Units 1, 3, and 4 caused severe structural damage.

A number of investigations followed the 2011 disaster. The Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), established by the Diet on October 30, 2011, was the first independent commission in the history of Japan's constitutional government. The Commission found that the nuclear regulators had been 'captured' by the power industry, suggesting collusion between the regulators and other players. Furthermore, the accident was clearly human-made and preventable. For example, in the years after 9/11, the United States required all of its nuclear power operators to prepare for situations that required coping with the loss of large areas of the facility due to large fires and explosions, including by requiring portable equipment. These requirements were set out in section B.5.b of an order issued by the U.S. Nuclear Regulatory Commission (USNRC) in

11 teachers, 70 children and nine teachers were killed, with four students and one teacher missing. In light of this, the Ministry of Education plans to make aspiring teachers take mandatory classes on disaster preparation.

Of the twenty or so nuclear power plants in Japan having about fifty reactors, the earthquake and tsunami affected five directly. Nuclear reactors in Japan are designed to shut down safely in the event of natural disasters. However, once a reactor is shut down, there remains a lot of residual heat and the reactor still requires cooling. This is generally done by circulating water. Furthermore, spent fuel is collected in a pool that must also be cooled. In abnormal situations, the top priority is keeping the reactor cool, which is why most stations are located near oceans or large lakes. However, plants need power to pump the cooling water.

The Fukushima Daiichi nuclear power station began operation in 1971. At the time of the disaster, Units 1, 2, and



1. Prevention of abnormal operation and failures.
2. Control of abnormal operation and detection of failures.
3. Control of accidents within the design basis.
4. Control of severe plant conditions, including prevention of accident progression and mitigation of severe accident consequences.
5. Mitigation of the radiological consequences of significant off-site releases of radioactive materials.

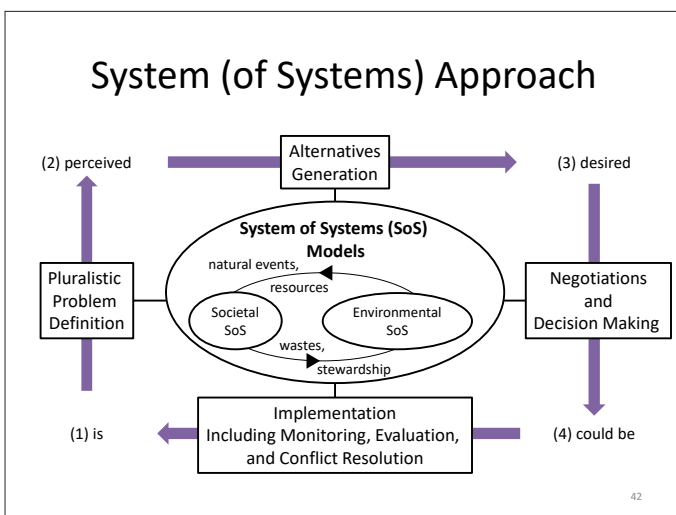
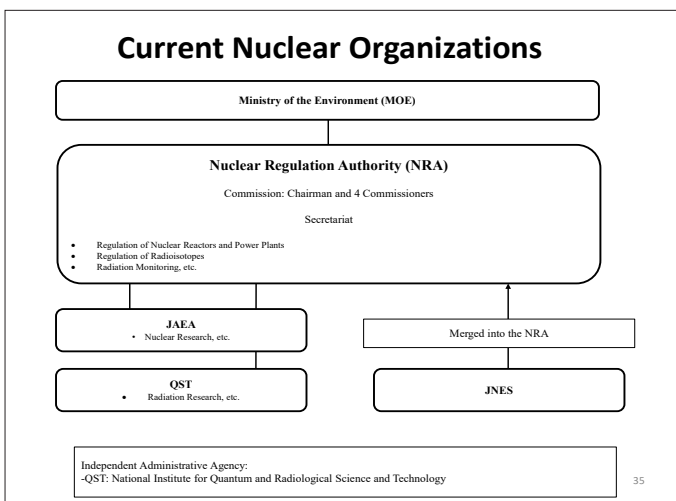
Ichiro Takekuro, head of TEPCO’s nuclear business prior to the accident, stated that TEPCO had focused on the first three levels, implying that TEPCO was not responsible for implementing the fourth and fifth levels. The regulators left it up to the operators to develop measures to deal with severe accidents and offered little guidance on what steps to take in the event that a major disaster caused severe conditions.

Relatedly, the Commission also found that there was no legal framework requiring retrofitting. This was problematic, because when Fukushima Daiichi was built in the 1960s, tsunami hazards and wave heights were estimated using records of past tsunamis. Updated research showed cause for concern. In 2008, TEPCO made trial calculations based on two information sources, including the Jogan tsunami of 869, which had a very similar projected location and magnitude to the wave that would strike in 2011. However, although TEPCO called for further study, no action was taken.

Moving forward, new regulatory requirements must include measures to deal with severe accidents. These should include the introduction of a retrofitting system; improved design to deal with natural hazards; improved measures to prevent and manage internal flooding; a more resilient power supply; measures against terrorist attacks; and the use of portable equipment. Furthermore, regulators should examine the validity of regional evacuation plans and mandate analytical techniques such as probabilistic risk assessment (PRA) to evaluate nuclear safety in a more complex, nuanced fashion.

There are still questions about whether the new nuclear regulatory regime in Japan is truly independent. Various measures have been taken to address this issue, such as no longer allowing individuals to be relocated to other parts of the government, but other problems still remain, such as the small size of the country’s expert pool. The Nuclear Regulation Authority (NRA) has a staff of approximately 900 in Japan, in comparison to 4,000 in the United States. NRA inspectors in Japan are able to visit reactors for spot checks at any time, but each American reactor has USNRC staff stationed there on a permanent basis. For all of Japan’s extensive nuclear expertise, it is unclear whether it has sufficient human resources to police operators effectively.

Despite these significant challenges and the long, tragic shadow of 3/11, it should be emphasized that Japan has a



2002. Japan’s Nuclear and Industrial Safety Agency (NISA) was made aware of the U.S. standards in 2009, but failed to require TEPCO to implement them. Had they done so, the accident might have been prevented.

The Commission also found that TEPCO had failed to implement an appropriate defence-in-depth strategy consisting of five levels:

long tradition of resilience and is leading the world in natural disaster risk management.



Following the presentation, the first commenter asked whether Fukushima Daiichi was up to code when built. Professor Fang responded that yes, it had been. That said, there was no retrofitting system in place, and so any changes were left up to the operator's discretion. In retrospect, it was obviously problematic to have backup generators and related panels in the basement. Moreover, the power cables and connections that were delivered did not match. Thus, while the plant was not behind code, neither was it up to best practices. However, regulators were not especially independent; while they had been considering taking action before 3/11, they were persuaded not to by the utilities, who were responsible for the sea wall design.

The next commenter observed that there is often talk of decommissioning, a highly politicized issue. The counterargument states that decommissioning leads to the undermining of education and research in nuclear engineering, ultimately weakening non-proliferation. Is this correct?

Professor Fang responded that there is, of course, an ongoing nuclear power debate. In Japan, the government plans to have approximately 20 percent of power from nuclear energy, but some want to eliminate it as a source entirely. Independently regulating nuclear energy requires specialized university graduates. Linguistically, Japan is also at a disadvantage, for example, relative to Canada, since Canada can more easily draw on a larger market of English-speaking experts, especially from the United States.

Another commenter then pointed out that in Japan, the labour market for experts is so small that many experts know each other, which raises a further challenge for truly independent regulation.

The next commenter pointed to the 'risk management success story' of aircraft safety, where the American standard has been used to great effect. On the other hand, the weakest link in aerospace safety has been human error, rather than mechanical failure. By comparison, with nuclear power, there is little opportunity for human error until accidents happen. In 2011, the biggest errors happened back at TEPCO's headquarters, not on-site at the plant. Is it possible to achieve similar benefits in this case by internationalizing American standards? How do the industries compare in terms of risk?

Professor Fang responded by pointing out that aerospace standardization has also had military benefits. One challenge for standardization, however, is the need to translate English standards into a different linguistic context. As far as human vs. technical errors is concerned, since Fukushima Daiichi lost electricity, it was difficult for TEPCO to assess technical details following the disaster. Without functioning instru-

mentation, you cannot advise the frontline on what to do.

The next commenter observed that the International Risk Governance Council recommends inclusive governance that involves many actors from many industries. In the United States, the military has acquired significant independent nuclear expertise—for example, by operating nuclear submarines. What is the military's role in regulating nuclear issues?

Professor Fang responded that the U.S. military does not participate in regulating nuclear power sites, but experienced former personnel can find jobs with the USNRC. Many universities have professors who can also lend their expertise to civil society groups and function as watchdogs. It is important to have different actors looking at the same issues from different perspectives. However, this can make it complicated to understand who really wields influence. For example, Congress sometimes tries to influence the USNRC, and the National Academy of Science had a committee that cannot agree on whether or not the United States actually has an independent nuclear regulator.

The next commenter asked about the education system. Regardless of whether one supports nuclear power or not, we have to live with nuclear power sites now and into the future. How can we build an education system that helps us to maintain safety when living alongside such complex systems?

Professor Fang responded that, on the natural hazard side, Japan has an excellent risk management system. However, tsunami *tendenko* is not something that everyone is able to do. It can be taught to elementary and junior high school students, for example, but in elderly homes, it equates to abandonment. We may want to relocate such facilities to higher ground so that they do not experience immediate tsunami impacts. Disaster planning and education need to consider many different stakeholders' perspectives.

The next commenter shared two observations. The first was a point about international safety advisory groups. None of the existing regulators meet all existing criteria, and all have both weaknesses and strengths; this is the nature of nuclear regulation. The second was a point about probabilistic risk assessment (PRA). One company in Shikoku has already begun to apply PRA to their practices. TEPCO is hiring more external experts and introducing PRA methods developed in the United States. It would be helpful if there were institutional incentives to use PRA, which can help to identify which particular safety measures are most efficient.

The next commenter brought up the question of independence. How should we conceptualize independence in the Japanese system? Should the Upper House have set roles, for example? Should bipartisan committees deal with nuclear problems?

Professor Fang agreed that independence is an important issue with which to wrestle. First, regulators must have a guaranteed term during which they cannot be fired by the government. The Commission in the United States is appointed

by the president and confirmed by the senate for a five-year term, during which they cannot be fired without cause. In Canada, there was a case in 2007 where it was found that a research reactor did not have two pumps connected to emergency power, as required by its license. The Canadian Nuclear Safety Commission (CNSC) told them that they could not operate without two pumps, leading to a medical isotope shortage. With the consent of all political parties, the government passed an emergency bill allowing the reactor to operate for 120 days despite the CNSC's licensing conditions. Some commentators were concerned that this removed the Commission's independence. Shortly afterwards, the government had the CNSC president stripped of her title, while allowing her to remain as a member of the Commission. She subsequently resigned and sued the government. The court

found that, under Canadian statute and common law, she had served as president at the government's pleasure. The government was thus within its rights to remove her from the position of president. In contrast, under the statute, her position as a general member of the CNSC depended on good behaviour; thus the government would have needed to meet a higher standard of procedural fairness to remove her from the Commission entirely, had they attempted to do so. This higher burden reflects the notion that regulatory independence requires a degree of job security. However, Commissions are administrative bodies that are established—and undone—by acts of Parliament. There is plenty of discussion in Canadian legal circles about the appropriate degree of deference that courts should show to administrative decision makers.

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Saturday, October 7, 2017, Hotel JAL City. Sendai, Japan

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