Akihiro Ohta of MLIT discusses policy changes post-tsunami

The way forward for infrastructure design in Japan

The archipelago that forms the modern nation of Japan sits at the nexus of four tectonic plates. The seismic activity these plates generate is a constant presence in daily Japanese life; more than 1,500 seismic events occur each year, including two of 5.0 magnitude or higher.\(^1,2\)

It comes as no surprise then that Japan leads the world in early warning systems to protect its population from disaster. Nor that the Japanese have a well-earned reputation for earthquake mitigation. Despite this preparedness, the 9.0-magnitude earthquake that struck off the northeast province of Tōhoku in March 2011 tested the resiliency of the nation in unprecedented ways.

A massive tsunami swept across the coastline within 30 minutes of the quake, changing entire landscapes and washing away villages and infrastructure. A 45-foot wave disabled the power supply and cooling at the Fukushima nuclear reactor, causing a meltdown in three cores and the release of radioactive materials. The Japanese government ordered the evacuation of more than 100,000 people from the surrounding area.\(^3\)

The human costs were high:
- 15,800 people died;
- 6,100 were injured;
- 2,600 are missing; and
- recovery costs are estimated at ¥17 trillion.

However, the damage to the nation’s infrastructure was remarkably low compared with what similar events have caused in other regions of the world. Mechanisms implemented long before 2011 to strengthen infrastructure against earthquakes, tsunami, and fire saved millions of lives while also mitigating economic losses. The infrastructure showed remarkable resiliency, attributable to the forethought of its flexible design.

Lessons from Japan

The farsighted decision to enforce some of the strictest quake-resistant standards in the developed world paid off, as very few building collapses occurred in areas unaffected by the tsunami. Meanwhile, reinforced shoreline breakwaters mitigated tsunami damage. Japan's bullet trains were programmed to automatically decelerate even before the earthquake hit, thus avoiding derailment—and providing an important object lesson in the vital role of infrastructure in disaster mitigation. The 2011 disaster also illustrated how preparedness contributes to protecting the social and economic fabric of a community.

Robust catastrophic planning has also contributed to social resilience. Early warning and alert systems, continuous national earthquake drills, and well-understood evacuation plans effectively limited the loss of life. The spirit of mutual assistance was widely on display. Groups of young people helped with the evacuation of the elderly from disaster-stricken houses and more than a million volunteers helped staff supply lifelines and assist in disaster relief.

Close cooperation between the public and private sectors was an indispensable part of the rescue, recovery, and reconstruction process. In several cases, local authorities had pre-established agreements with private companies to provide basic necessities to evacuees.

Building back stronger and smarter

While Japan’s first response has been hailed as a model for other disaster-struck regions to emulate, the challenge now is long-term infrastructure rebuilding. Rather than repairing or replacing the damage, cities and towns are using the reconstruction effort to introduce innovative state-of-the-art technologies. They are building smarter, more efficient infrastructure to ensure a vibrant future.

A number of ground-breaking initiatives now underway in the Tōhoku area focus on leveraging new technologies to develop safe, sustainable, energy-efficient communities. Lessons from the 2011 earthquake are being incorporated into “Smart Community” and “Future City” designs to revitalize the region’s economy and support the redevelopment of communities affected by the disaster.

Yutaka Saito, President & CEO of Information & Telecommunication Systems Company for Hitachi, says public-sector officials are making the effort to build a smart city—or city of the future—by applying innovative IT that combines safety and comfort. The private sector is playing an essential role in the development of the future city and its infrastructure, contributing innovative ideas, solutions, and technologies in a collaborative process with the public sector.

Mayor Emiko Okuyama of Sendai notes that the success of these future-oriented initiatives can serve as an example to other cities striving to address the complex challenges of demographic, climate, and economic change. Forged from the chaos of devastation, Japan’s ground-breaking solutions ensure a more sustainable future in response to the global challenges of the 21st century.

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In March 2011, a 9.0-magnitude earthquake struck northeastern Japan’s Tōhoku region, causing a tsunami within the hour—a low-probability, high-risk event that is predicted to occur once every 1,000 years. While Japan’s long-term investment in resilient infrastructure minimized loss of life from the earthquake, the unforeseen tsunami did result in a death toll of some 15,800.

Meanwhile, the economic loss from the earthquake tallied more than $200 billion, one of the world’s most expensive disasters to date. By early 2013, Japan’s MLIT had implemented policy changes in land use, disaster risk mitigation, and infrastructure resilience that offer lessons to other disaster-prone regions of the world.

To what extent can you attribute the pace of recovery and reconstruction to Japan’s legendary reputation for investing in disaster-resilient infrastructure?

After the widespread structural damage from the Great Hanshin earthquake of 1995, we initiated a national effort to make our buildings more earthquake-resistant. In my view, our progress on that count helped limit the damage from the Great East Japan earthquake of 2011. Our bridges held up. So did our reinforced shoreline breakwater and seawall facilities, which also acted as a barrier against the intensity and speed of the tsunami.

What role did pre-disaster training play in the recovery effort?

A very significant role, actually. A coordinated effort by trained personnel from The Japan Self-Defense Forces, the US armed forces, local and national firefighting units in Japan, and MLIT teams—together with residents from local communities who had been trained in disaster mitigation and recovery techniques—proved extremely effective in accelerating the pace of recovery and reconstruction. For example, MLIT teams, together with The Japan Self-Defense Forces, quickly and effectively executed “Operation Comb”—so-called because the transport route resembled a comb—which paved the way for emergency transport routes from inland to the devastated coastal areas (see following page for an illustration of Operation Comb). Continuous training and simulation were among the vital factors in the successful execution of this operation.

Our ongoing disaster-prevention education and training—with simulated drills—contributed substantially to our recovery effort. We have to continue to prepare for the reality of natural disasters with exhaustive, large-scale training programs.

In retrospect, were there areas in which you might have done better?

Certainly. For example, in preparation for the tsunami, we evacuated residents to nearby sites simply because that’s what our scenario-planning called for. But we hadn’t considered any scenarios involving monster tsunamis because they are forecast to occur every 1,000 years.

Our fundamental challenge is to maintain constant preparedness for an event of the scale of the tsunami. We cannot continue to assume they are unlikely to occur. We must ensure all residents are informed in time when an earthquake...
or tsunami or blizzard strikes. For that to happen, we must improve modes of communication for all first responders. These measures will require changes in regulations, which we are seeking. Besides, we must retrofit our buildings as necessary; therefore, MLIT worked on revising the law.

**What fundamental policy changes have occurred since the Great East Japan earthquake?**

Our fundamental views on infrastructure development continue to evolve. Some residents have historically viewed public works projects in Japan as wasteful. However, in the aftermath of the earthquake, the fields of disaster prevention, mitigation, and maintenance are now considered part of the mainstream in public works projects—and we must launch comprehensive initiatives to build disaster-resistant infrastructure.

We must also undertake projects that improve a building’s structural resistance to earthquakes and implement countermeasures against aging and obsolescence in our infrastructure. Given our falling birth rates, aging society, and energy needs, the solution isn’t to pave over our country with concrete or build higher breakwaters. We need flexible, environmentally sound, community-based development. I was a member of my sumo wrestling club at university so I would liken the infrastructure we need to Ichiro Suzuki of the New York Yankees: muscular, yet lithe and speedy.

Development projects in Japan have typically proliferated in rural areas to accommodate population growth; we need a policy shift that supports the creation of compact cities in urban areas, where residents don’t have to rely on automobiles for their daily lives. We must focus on smart homes with roof-mounted solar panels and insulation that helps them stay cool in the summer and warm in the winter to conserve energy. Concentrated neighborhoods of smart homes within these compact cities is one of our goals of community development.

**What role can the private sector play in post-disaster rebuilding of infrastructure?**

The earthquake halted all forms of transit completely, causing train stations to overflow with commuters who had no way to get home in the Tokyo metropolitan area. We must do more to address and solve this problem with joint public-private sector collaboration, especially at key hubs such as Shinjuku, Ikebukuro, Yokohama, and Tokyo stations. In Ikebukuro, one of the largest districts...
Residents who work for the local construction industry, for example, are not only employees of the local construction company but also residents of the community affected by the disaster.

They are willing to defend their community and collaborate with local government on a daily basis. Though it would be hard to quantify this collaboration as an economic benefit, this approach does lay the groundwork for healthy construction-related industries with strong roots at the community level.

The construction industry, in particular, has traditionally played an instrumental role in Japanese society as a key source of employment. In that respect, the industry plays an important role in disaster management and reconstruction—just as a doctor would in the neighborhood medical clinic.

How do you address the challenges of maintaining existing infrastructure?

In the 1970s, we built some 10,000 bridges in Japan every year. Now the average is about 1,000 or so new bridges a year. In effect, the trend has reversed sharply and we’re now approaching zero. The challenge we face now is a steep uptrend in the need for infrastructure maintenance.

We have to extend the useful service life of our amassed mountain of infrastructure. The typical useful service life of 30 to 50 years is
not adequate anymore. The field of maintenance engineering as a formal academic discipline will take on new importance.

Research into technologies for the seismic isolation of buildings is currently underway. Countermeasures against ground liquefaction and technologies for fire-resistant wood-frame housing are also being studied. We must find ways to make our existing infrastructure more resilient while holding down the associated costs.

**Public-private partnerships require infrastructure to be managed on a life-cycle basis, which means future disaster risks must be taken into account when building or rebuilding infrastructure. Please address how this should be done.**

Japan has accumulated decades and more of experience and expertise in erecting buildings of quality that last a very long time. Take the example of the Horyuji Temple, which was built in the seventh century. One of Japan’s oldest temples, it is also the world’s oldest surviving wooden structure. Over the years, we’ve reinforced the temple with extensive maintenance measures, including the addition of diagonal crossbeams.

I also found out recently that a particular five-storied pagoda has a thick central pillar that oscillates like a pendulum in sync with the shock waves of an earthquake, thus making the entire structure earthquake-resistant.

Given Japan’s accumulation of knowledge in building disaster-resistant infrastructure throughout history, we now have to focus that knowledge on maintaining the useful life of our infrastructure over the long term. We can do that via collaborative public-private partnership arrangements. In my view, we must implement measures that prepare us for future earthquakes in susceptible areas of the country—such as the Tōkai and Tōnankai regions as well as the Nankai Trough.

Ultimately, we must look beyond pure countermeasures. With advances in technological development, we must build communities that lead the world in their flexibility and livability and attract people from other parts of the world.

**What lessons do Japan’s experience with the Great East Japan earthquake offer the global community?**

I look forward to providing a systematic overview of Japan’s globally heralded disaster-risk preparedness, mitigation, response, and recovery techniques to people all over the world.

I believe Japanese industry derives its collective strength from all the people on site, working silently through the long, hot days of summer and the cold snows and rains of winter. It’s not only their fortitude that is remarkable but also their diligence as they work quietly to advance the recovery effort.

As a society, we value not only the technology required for advancement but also the individuals who support that technology. I hope we can share with the international community the importance of ordinary people in building a resilient community.