# Risk Management Policies for Mega-Cities: Lessons from Tokyo on March 11, 2011

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**Abstract**

The Tokyo Metropolitan Area is known as the largest metropolitan area in the world. The city has been facing severe disasters like the Great Kanto Earthquake in 1923, as well as more routine typhoons and floods. There have been significant losses caused by these disasters, however, because of their consistency, risk management policies have accumulated over time. The complex disaster on March 11, 2011 caused by the Great East Japan Earthquake, and subsequently the tsunami and damage to the Fukushima nuclear plant, gave a huge impact on Tokyo, 400 kilometers away from the epicenter. However, Tokyo in 2011 offers us some visible success of several risk management policies that have been refined over the past century. On the other hand, fragility has been exposed particularly to whom rely on the highly developed urban infrastructure of the mega-city. Reviewing these lessons learnt from the events of March 2011 in Tokyo, some implications to enhance the risk management policy are sought. One outlier is Roppongi Hills, which was not affected by the disaster at all and became a base to serve for the neighborhood upon the disaster. While Roppongi Hills provides several best practice lessons, it is a relatively small area compared to the whole Metropolitan Region. To understand the current level of risk management measures for disasters in Tokyo, strengths and weaknesses that correspond to the four stages of crisis management are presented. This aims to be a template to provide references in setting the risk management policies for the emerging mega-cities especially in Asia.

**Keywords:** Great East Japan Earthquake, urban risks, Tokyo Metropolitan Area, mega-city, risk management policies

## Introduction

According to UN-HABITAT, half of the population of the world lives in urban areas and this ratio is expected to increase to 70% by the year 2050. Meanwhile, the total urban area occupies only 3% of the surface of the earth.[1] Urban concentration in this small area is now driven by the mega-cities, which hold millions of people. Although urbanism provides various benefits, it should be noted that the high population density and the concentration of wealth in these tiny spots on the globe increases the exposure of such places to risk. Nowadays, many people are loudly linking natural disasters to climate change, and cities that have been considered safe

hitherto are at risk. Simultaneously, complex disasters, such as a combination of floods, plant accidents, moral hazard, and pandemic diseases, can be triggered by a single natural disaster. The employment of risk management policies that are unique to the mega-cities seems to be an urgent matter as the growth of cities accelerates.

The Greater Tokyo Area, composed of the capital Tokyo and the three surrounding prefectures of Kanagawa, Chiba, and Saitama, is known as the largest metropolitan area in the world with a population of 35 million and a GDP of US$1,479 billion. Although mega-cites in the emerging countries are expected to achieve significant growth in the coming decades, Tokyo will remain top in 2025 both in terms of its population[2] and its GDP.[3] Domestically also, Tokyo is dominant. For example, the three prefectures, Iwate, Miyagi, and Fukushima, which were most affected by the Great East Japan Earthquake, make up 4% of the national population and the nation's GDP, while the Greater Tokyo Area accounts for 28% of the national population and 32% of the nation's GDP. (Figure 1)

Tokyo, formerly known as "Edo," has been developed as a capital city since 1590. The city was designed with a castle at its center and with the downtown in a circle around the center. This unique concentric structure has been maintained into the modern period. A modern infrastructure, such as railways and highways, is laid out on this urban form, and the accuracy and successful operation of these seamless services allow people to live together in this huge city and enjoy a high quality of life. Supported by a mature economy and a developed infrastructure, Tokyo also enjoys high exposure as a tourist destination, as well as being a global center for innovation. For instance, its overall position in the Global Power City Index has been fourth, following the three world famous cities of New York, London, and

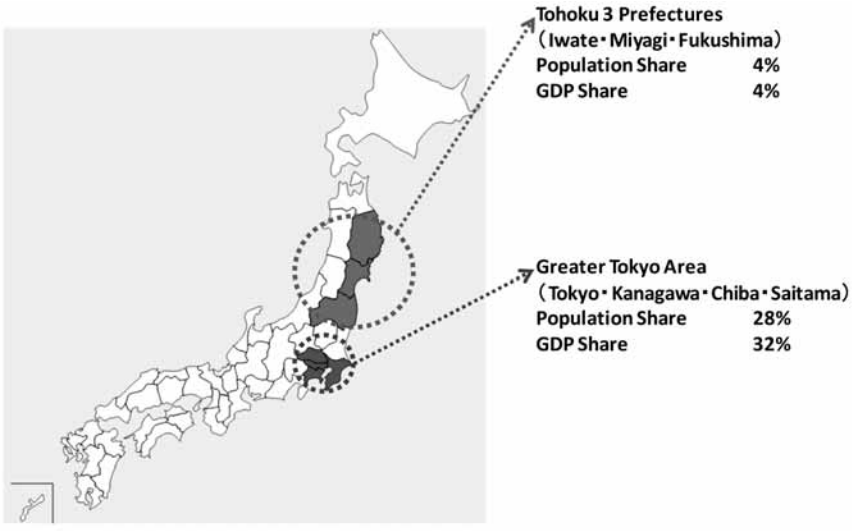



**Figure 1** Comparison between Greater Tokyo Area and Seriously Damaged 3 Prefectures in Tohoku

Paris.[4] Tokyo not only functions an engine for Japan, it also plays a critical role as a global hub.

The Great East Japan Earthquake was the largest earthquake to hit Tokyo since the Great Kanto Earthquake in 1923. Although, unfortunately, some casualties were reported, there was also an opportunity to examine the risk management policies that had been put in place over the decades since the Great Kanto Earthquake. Elaborating on Tokyo's successes and failures, which were revealed while the city was coping with the series of risks that were triggered by the March 11, 2011 event, provides a reference for the establishment of risk management policies in the emerging mega-cities of Asia.

## 1. The Physical Damage to Tokyo from the Earthquake

### *Casualties and Damage to Property*

The complex disaster due to the earthquake in Northeast Japan on March 11, 2011, which was followed by a tsunami and a nuclear plant accident, caused some damage to Tokyo. The scale of the crisis can be imagined when it is compared by combining three disasters in the United States, the San Francisco Earthquake of 1906, Hurricane Katrina in 2005, and the Three Mile Island nuclear disaster of 1979.[5] 400 km away from the epicenter of the M9 earthquake, the tremor in central Tokyo was measured at level 5+ out of the 7 levels in the Japan Meteorological Agency's measurement system.[6] While the Tohoku region near the epicenter recorded level 7, which is equivalent to the level in the center of Kobe city by the Great Hanshin-Awaji Earthquake in 1995, tremors in downtown Tokyo were relatively low. Nonetheless, around ten houses collapsed and seven people were killed in the downtown area of Tokyo. It is important to note that the limited amount of damage constitutes an improvement on the seismic performance of Tokyo's buildings since the Great Hanshin-Awaji Earthquake in 1995. Also, there were no casualties caused by fire in Tokyo while more than half the 100 thousand deaths in the Great Kanto Earthquake were caused by the quake-triggered fires. The introduction and distribution of the system 'my-com-meter,' which senses a quake and shuts down the gas supply in each unit of a residential building helped to prevent fires.

Commercial buildings in Tokyo were not seriously damaged by the Great East Japan Earthquake either. For instance, out of 100 properties managed by the Mori Building Company, which is a major property holder and manager in Tokyo, 70 were damaged by the quake. However, most of the repair work that was needed as a result was limited to minor repairs to the exterior or interior walls and surface finishes.[7]

While most of the casualties resulted from the tsunami in the Tohoku region, Tokyo was not affected by a tsunami this time. The highest wave at Tokyo's Harumi waterfront was reported to be 1.5 m. The levees along the Tokyo shoreline are from 4.8 m to 8.0 m high, and they are designed to withstand the kind of flooding that came with the Ise Bay Typhoon in 1959, which is known to be one of Japan's worst post-war disasters.[8]

### *Damage to the Infrastructure*

The impact on the infrastructure, such as bridges, highways, and railways, was also less visible. This reflected the work done to reinforce the infrastructure, which had been carried out since 1995. Train systems on a 30 km radius from the center of Tokyo station suspended their service at once, but 40% recovered within the day, and this percentage reached 95% the next day, after due inspections had been carried out.[9]

Utilities, such as electricity, gas, and water supplies, were not seriously affected by the quake. The conventional steel gas pipes buried underground have been replaced with flexible and durable polyethylene pipes. Water pipes have also been switched to a seismic-resistant system, so no leaks were reported this time. Tokyo, as of March 11, 2011, offers us visible signs of the success of several risk management policies that have been refined over the past century, and specifically within the past 15 years.

However, even though there were no casualties, severe soil liquefaction was reported in the Tokyo Bay area, especially in Chiba prefecture. The total liquefied area approached 42 square kilometers, which is the largest area of liquefaction ever.[10] As a result, 30 houses collapsed and over 1,000 houses were damaged in Chiba. The main reason for the liquefaction being concentrated in Chiba was the method that had been used to reclaim the land. To protect the environment, sand under the bay was re-used, and this resulted in an unstable foundation for the reclaimed land. On the other hand, the reclaimed land where the ground had been treated and improved with the sand compaction pile (SCP) method was not liquefied. In response to the 1964 Niigata Earthquake, where the collapse of buildings due to liquefaction occurred in Japan for the first time, the Building Standards Act was amended in 1978 in order to enforce ground improvement methods for land reclamation, but most of the areas liquefied in Chiba had been established before this act.

## 2. Socio-Economic Issues Exposed by the Earthquake

### *Stranded Persons*

While no major infrastructural damage occurred and the number of deaths was limited, Tokyoites still faced serious inconvenience. This was particularly so for those who rely on the highly developed urban system in the center of the city.

The earthquake struck at around 3 p.m. on Friday. Initially, people in offices and schools thought they could go home as usual. Tokyo is equipped with one of the most sophisticated train systems in the world, and this system maintains a gigantic urban structure that allows 10 million people to commute systematically and every day in and out of the city boundaries of Tokyo. Right after the quake, all the lines were shut down because of the need to monitor possible damage from the quake. 40% of the lines, which were mostly subways, recovered within the day, but the other lines stayed down until the next day. This caused an unprecedented phenomenon, the overflow of people around the city. The major terminals, such as Tokyo

Station and Shinjuku Station, which usually accommodate over 1.5 million passengers each day, asked people to leave the stations, which closed their shutters, and this meant that people then had no place to stay.

Consequently, people started to use the lines that had restored their service and made detours. Some people walked several hours back to their homes, others bought and rode a bicycle home or got picked up in the family car. Others still returned to their offices, or stayed at the refuge areas that were set up at public facilities and shopping centers. There were no riots and things remained organized. However, the lines of people walking along the sidewalks did not disappear until the morning. (Image 1) The total number of stranded people is estimated at 3.52 million by the Tokyo Metropolitan Government.[11]

Source: Yomiuri Shimbun News

**Image 1** Stranded Persons walking back home

This experience made people realize the risk of their daily long-distance commute, and since this event occurred a lifestyle of living quarters-workplace proximity has attracted people's attention. Risk management policies aimed at stocking foods and supplies at offices and schools in the case of an emergency have been highlighted, and the Tokyo Metropolitan Government enforced a new ordinance to secure these measures in March 2012.

### *Urban Threat from the Nuclear Plant Accident*

More inconvenience resulted from the accident at a nuclear plant. This caused new hardships for Tokyoites. Electricity shortages occurred after all Japan's nuclear plants were shut down. This resulted in a reduced number of trains and shut off barrier-free facilities in public spaces, such as the escalators. Many elderly people and families with infants found their access to the city restricted. The government ordered each family to reduce their use of electricity, so people tried to save energy by turning off lights and by carefully controlling the temperature of their air condi-

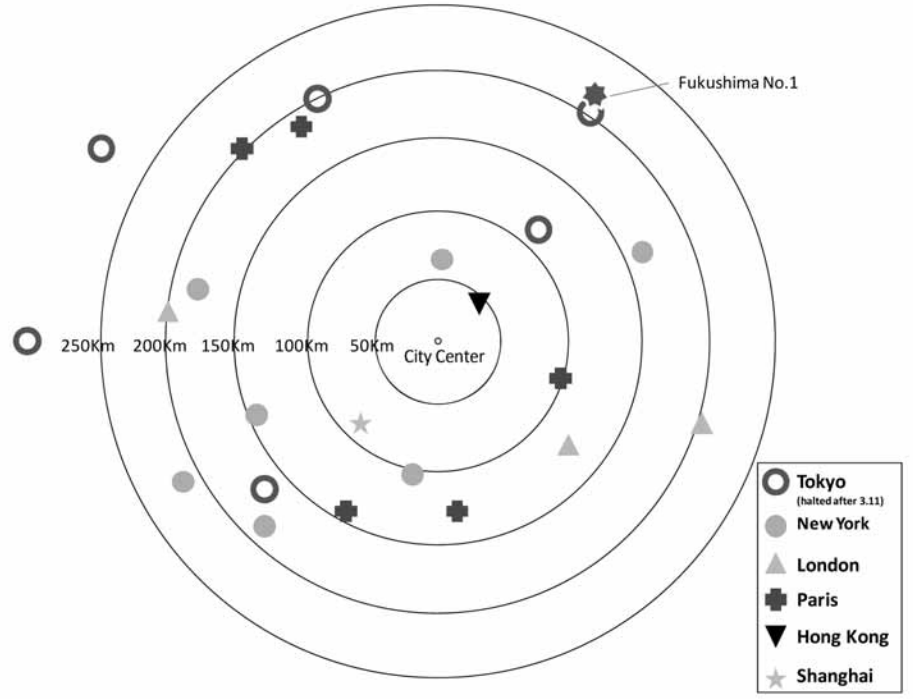



**Figure 2** Active Nuclear Plant Locations relative to City Centers of Major Global Cities

tioners. People suffered a certain amount of discomfort and stress as a consequence. Furthermore, there was a shortage of general supplies, with shelves at "Convenient Stores," which are usually full of groceries 24 hours a day, becoming empty. One of the worst problems was the pollution caused by the irradiation of the tap water. Even though official announcements regarding the pollution levels declared that these levels had no affect on the human body, people rushed to stores to hoard bottled water and this caused a shortage of supplies for infants for whom such water is essential. As such, the comfortable urban life of Tokyoites, which results from dense, systematic and progressive urbanization, was threatened. All this inconvenience made Tokyoites lose their confidence about living in the largest mega-city in the world.

The nuclear plant accident was repeatedly described by government officials as an "Unexpected Accident." However, after it happened, people recognized that there is nothing "Perfect" about man-made systems. Figure 2 shows the location of the active nuclear plants around the major cities relative to the center of each city. "Global Cities," with a high accumulation of functions within the city, should remember that they are not totally free of the risk of nuclear accidents, even though their nuclear plants lie outside the city's boundaries.

## 3. Implications for Risk Management Policies for Mega-Cities

***Modern Seismic Performance***

The breakthrough in improving the seismic performance of buildings was triggered by the 1978 Miyagi Earthquake in Northeast Japan. The Building Standards Act was amended due to the serious collapse during the earthquake of buildings with a "Piloti Style" first floor, and structural design criteria were dramatically tightened. Following the 1995 Great Hanshin-Awaji Earthquake, the Act for the Promotion of Renovation for Earthquake-Resistant Structures was implemented, and in 2000 the Building Standards Act was amended again to introduce performance-based design to buildings. The Earthquake Building Code Scandal in 2005[12] also resulted in the acts becoming stricter regarding structural design when a peer check system and stronger penalties were introduced. In this way, and as a result of lessons learnt from past experience, seismic building design standards have rapidly improved. In the 1995 Hanshin-Awaji earthquake, 24% of the reinforced concrete buildings constructed before the 1981 amendment collapsed or were severely damaged. Most of the older buildings that collapsed were built under pre-1981 standards or were wooden structures without sufficient earthquake proofing, such as adequate cross-bracing. No buildings with prefabricated walls collapsed in the 1995 earthquake.[13] Currently in Tokyo, 80% of the residential buildings and 87% of the elementary and junior high schools are earthquake-resistant[14], but it is highly desirable that the remaining residences and schools be brought up to standard as soon as possible.

Meanwhile, the Great East Japan Earthquake on March 11 tested the seismic performance of the high-rise buildings in Tokyo, which are relatively recent in the history of Japan's construction industry. In central Tokyo, there are approximately 400 high-rise buildings that are over 100 meters high.[15] One shake of a high-rise building during an earthquake is said to be of long duration. This can resonate with a long-term oscillation of between 2 and 20 seconds. Damping devices were proved to be effective both in preventing resonance and in protecting the buildings. The introduction of damping technology to high-rise buildings became popular in the 2000s in Japan, and its installation in buildings is now critical for seismic performance. The 223-meter-high Shinjuku Center Building was built in 1997 and was renovated in 2009 in order to install damping devices. In the March 11 quake, the maximum displacement of the building was 54 cm, with these devices limiting the tremor of the building by 22%.[16] The 238-meter-high Roppongi Hills Mori Tower was built with a damping system and this was shown on analysis to reduce the displacement at the top of the building after the quake by nearly half.[17] In fact, there was no damage reported to Roppongi Hills Mori Tower after the March 11 quake, while Tokyo Metropolitan City Hall experienced substantial damage, such as collapsed office ceilings. Consequently, the city hall was renovated in order to install a damping system.

### *Redundant Energy Supply*

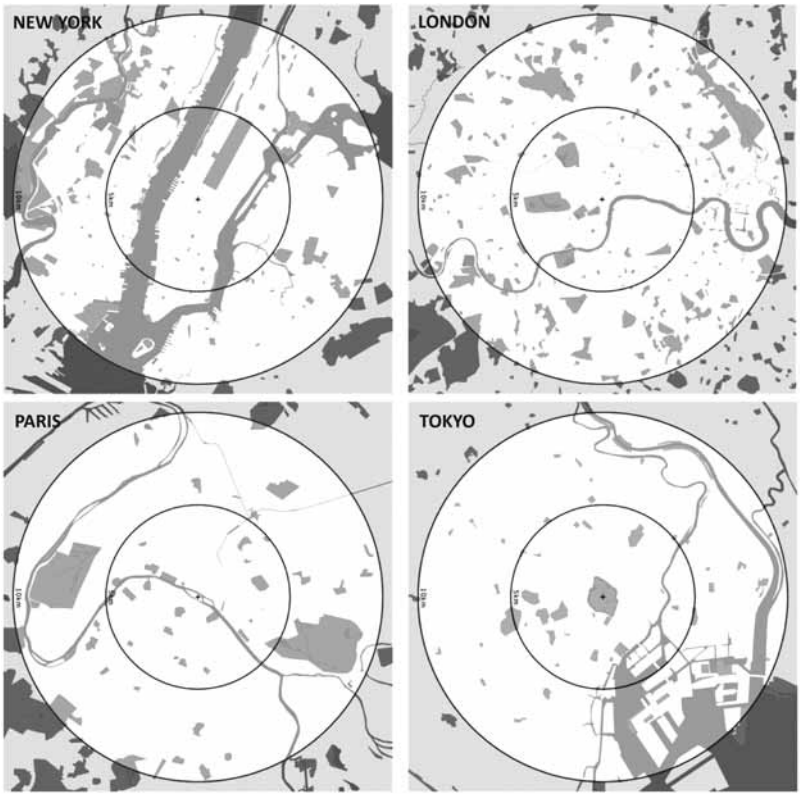
The Great East Japan Earthquake also revealed the vulnerability of Tokyo's energy supply in such an event, because of planned blackouts and the restrictions on electricity usage in the summer, both of which were ordered by the government for the first time in 37 years. A redundant supply of energy, which offers alternative energy sources and providers, has become important when it comes to maintaining a mega-city's ability to cope with a disaster. At the time of the March 11 quake, Roppongi Hills was the only complex which was operating its own power plant in Tokyo. In 1995, the Electricity Business Act was amended to enable private companies, besides the major electricity companies, to produce and supply electricity for business purposes. Upon the development of Roppongi Hills, the Roppongi Energy Service Company was established to run an exclusive LNG (Liquefied Natural Gas) power plant to supply electricity to the entire Roppongi Hills complex. Since this power plant is sustained by gas from the Tokyo Gas Company, it was not affected by the power blackout by the Tokyo Electric Power Company after the earthquake. To preserve this redundancy, Roppongi Energy Service also has a contract with the Tokyo Electric Power Company, in case of an emergency, in order to receive electricity. However, after the March 11 earthquake, Roppongi Energy Service provided the residual electricity of Roppongi Hills to the Tokyo Electric Power Company.[18]

Since the earthquake, Roppongi Hills has attracted the attention of overseas corporations especially because of its ability to carry on business operations in a crisis. Learning this lesson, as part of the public sector, the Tokyo Metropolitan Government initiated a policy to realize a redundant energy supply. Tokyo has been relying for about 80% of its electricity on production based outside Tokyo, including the nuclear plants in Fukushima.[19] To increase the level of self-sufficiency in energy became a serious issue, and the local government sought to build a new LNG power plant in the Tokyo Bay area. The electricity produced by the plant could be about 1 million KW, which almost equals the energy produced by one nuclear reactor. This action enhanced the creation of a city-wide redundant electricity supply system.

### *Safe Urban Blocks*

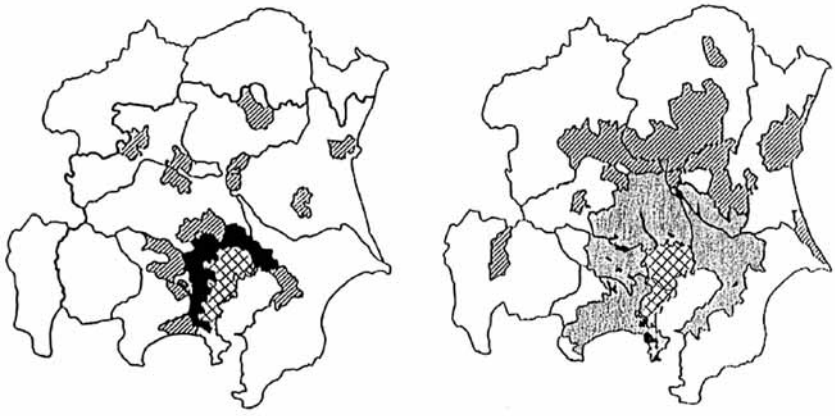
Since the March 11 quake, the contrast between safe and unsafe places in Tokyo has become clear. Tokyo is a city that has fewer open green spaces than other major global cities. (Figure 3) It is also rare in that the total area of open green space decreases the further one moves out from the center of the city into the suburbs.

In 1958, the government created a plan to introduce sustainable urban growth in the national capital area by referring to the Greater London Plan. The government tried to introduce a Green Belt around Tokyo's city center. However, the policy was not properly implemented due to opposition from the land-owners in the areas designated to be part of the Green Belt. These areas were consequently developed as urban areas. In the end, the government gave up the idea of a Green Belt and removed the policy with the revision of the National Capital Area Master Plan in




Source: Global Power Inner City Index 2010, Institute for Urban Strategies, The Mori Memorial Foundation

**Figure 3** Comparison of Green Open Space for Tokyo and Three Major Global Cities



Source: National Land Agency

**Figure 4** National Capital Region Master Plan (1958 left and 1968 right); Black zone is the planned Green Belt

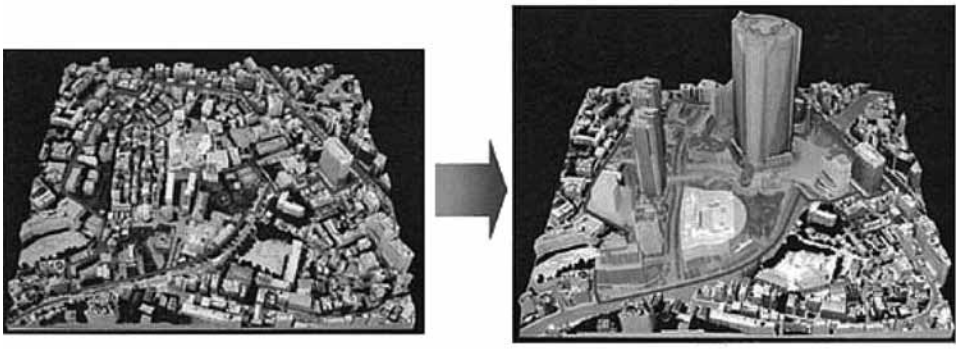
Source: Headquarters of the Governor of Tokyo,
Tokyo Metropolitan Government

**Figure 5** Zones Expected to receive Detrimental Damage in the Case of a Disaster

1968.[20] (Figure 4)

Since then, Tokyo has been developed aggressively with no attention being paid to maintaining open green spaces, which are essential from the point of view of disaster management. Open green spaces not only prevent fire from spreading but they also serve as a base for fighting fires and for accepting refugees. Figure 5 shows a map created by the Tokyo Metropolitan Government, which highlights the "Zones expected to receive detrimental damage in the case of a disaster." The total area of these zones is 7,000 ha, which is 11% of the total area formed by the 23 wards of Tokyo. 1.8 million people currently live in these zones, which have barely any open green space and are congested with wooden houses. These zones are not slums, however. In fact, many are moderately wealthy; there are just no incentives for property owners to redevelop the neighborhood, including their own properties, to create new open spaces to make their area safe.

Meanwhile, the central area of Tokyo can be seen from this map to be safer. One reason is that the redevelopment of the central area is more advanced than the suburbs. Since 2002, Urban Regeneration projects have been carried out as a matter of national policy, and a lot of new mixed-use complexes, based on towers and open spaces, have emerged. Roppongi Hills in Figure 6 represents this style of development, and it has been followed by other mega-complexes, such as Tokyo Mid-Town. These complexes, developed in the 2000s, clearly appear, after the March 11 quake, to be safer. In fact, Roppongi Hills was not only unaffected by the earthquake, it also accommodated thousands of refugees who were not able to go home by providing ample stocks of food, water and blankets. As has been shown, while Roppongi Hills can provide several best practice lessons, and is the largest privately based develop-



Source: Mori Building

**Figure 6** Roppongi Hills before (left) and after (right) the development

ment in Tokyo, it covers a relatively small area, compared to that of the entire mega-city region.

***Resilient Government, Communities, and Individuals***

The March 11 earthquake was not an "unexpected" disaster for Tokyo, even though the metropolis experienced its largest tremor since the Great Kanto Earthquake. Even the appearance of stranded people had been predicted, responses, such as opening up government facilities and public schools for those people who had been stranded, was promptly carried out by government staffs. In fact, many measures in the plans and manuals served to provide resilience to the city.

The Business Continuity Plan (BCP) for the Tokyo Metropolitan Government may be among the most sophisticated in the world in terms of its countermeasures in times of disaster. The plan designates 1,061 of the government's 2,884 services as a priority in terms of the provision of continuity in Tokyo's services and facilities. It specifies target times for the recovery of these services after an earthquake, taking potential understaffing into consideration. Tokyo has also created the Post-Earthquake Recovery Manual, which presents roadmaps for recovery for each of its districts, based on the scale of damage expected, and the city annually holds disaster drills, which are tied into the manual.

Meanwhile, communities complement government efforts in disaster preparation through the formulation of district continuity plans (DCP). Businesses around Tokyo Station have formed the Neighborhood Community Association around Tokyo Station for Disaster Management, which seeks to address the challenges posted by the expected stranding of 600 thousand commuters around the station after a large earthquake centered on Tokyo.[21] These challenges cannot be tackled by any single company, so the association's network aims to cope with a major quake in a cooperative way. They can effectively gather information on the safety of individuals, guide commuters who are trying to walk home, distribute food and water, and perform other crucial community tasks. The organization is thus an example of putting into practice the view that in a disaster, community resilience,

based on the concepts of self-help and cooperation, is more effective than waiting for public assistance.

Finally, each individual has to be resilient and act responsibly during a disaster. Along the coastal area in the Tohoku region, a legend has been passed on from previous generations which instructs people, when a tsunami arrives, to immediately escape from the coast without glancing anywhere else but the hills and not to care about other people. This may sound slightly barbaric, but the expectation is that everybody can finally meet on the hill if everyone followed this rule. It is estimated that there were about 500 thousand people in the tsunami-flooded area at the time of the earthquake on March 11 in the Iwate, Miyagi, and Fukushima prefectures, and that the casualties totaled approximately 20 thousand. If there had been no experience with tsunamis, including frequent evacuation drills, the casualty figures could have been one digit larger. However, in a mega-city, the situation might be slightly different because of the high population density. For instance, right after the quake, people rushed to the stations to reach their homes as soon as possible in order to confirm the safety of their families. As the stations were shut down, a massive number of people could not find their way home and they overflowed onto the plazas and streets, raising the chance of moral hazards. Even in this situation, no rioting or looting took place. People in Tokyo have been trained to share space in congested trains, streets, and sidewalks since the period of high economic growth during the 1970s. Thus, the experience and morality of each individual, especially in dense urban spaces, is important in a disaster if everyone is to survive. Daily preparedness for disasters by creating resilient individuals is a primary measure.

## Conclusion

Risk management policies in Tokyo have been polished as a result of its record of disasters in history. However, the Great East Japan Earthquake on March 11, 2011 proved that these policies were not sufficient. Forecasts show that there is a 70% chance of a great earthquake occurring in or near Tokyo within the next 30 years.[22] Therefore, just like after the earthquake in 1995, urban systems need to continue to implement risk management policies.

To understand the current level of risk management measures for disasters in Tokyo, Figure 7 has been created to easily identify strengths and weaknesses that correspond to the four stages of crisis management: Mitigation, Preparedness, Response, and Recovery.[23] Tokyo's strengths can be seen in its high design standards regarding seismic and fire performance, which are physical aspects, together with the well-organized Tokyo's Business Continuity Plan and the Post Earthquake Recovery Manual, which represent certain operational aspects. On the other hand, the weaknesses, such as the existence of the congested wooden house zones, which result in the lack of open space for egress and firefighting, are clearly negative factors. To properly cope with the next earthquake, even though the timing of that earthquake is uncertain, policies to confront these weaknesses and change them into strengths should be implemented. In particular, the redevelopment of the zones

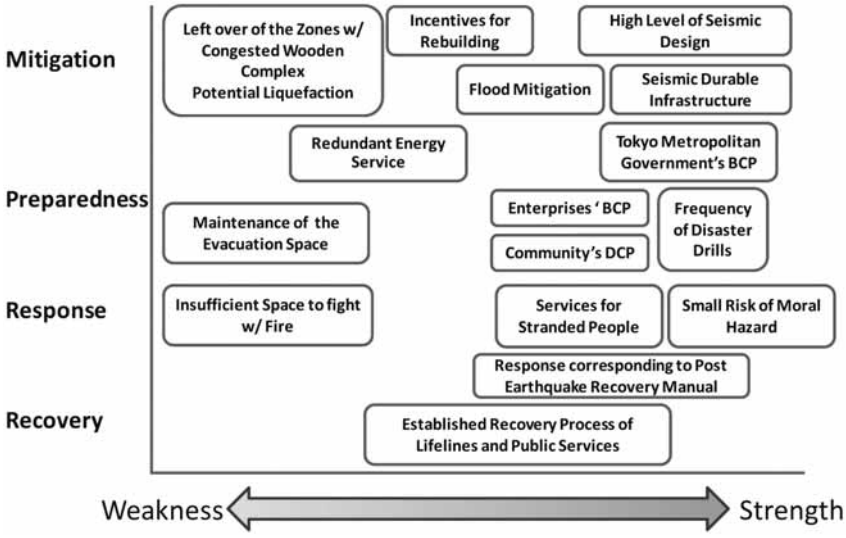
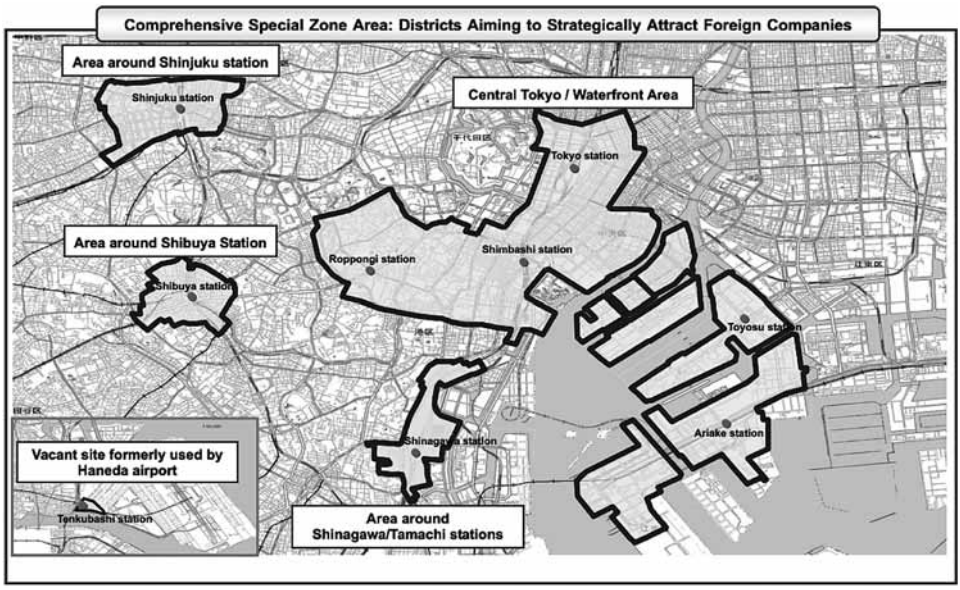



**Figure 7** Strengths and Weaknesses of the Risk Management Measures corresponding to the Four Stages of Crisis Management

where detrimental damage in a disaster can be expected, as designated by the Tokyo Metropolitan Government, is an urgent measure that needs to be implemented as soon as possible. Within the entire Tokyo region, the city center is relatively safe, but, since most of the nation's central functions, such as its parliament, its ministries, and the head offices of its major companies are concentrated in the central core, the level of safety should be further enhanced. Once there was an argument to relocate the capital's functions to other regions outside Tokyo. However, this has not been realized after studies compared the overall benefits against all the disadvantages that would result from such a relocation. In fact, it has been recognized that there is no place that is 100% free from an earthquake even if earthquake engineering has made remarkable progress in recent times. Tokyo has no choice but to squarely face the challenges presented by the world's largest metropolis and its massive conglomeration of people, communities, businesses, and infrastructure.[24] The Japanese Government decided to introduce new "Special Zones" in central Tokyo to accelerate urban regeneration to mitigate future disaster risks and to provide international urban platforms that can attract people, companies, and investment in order to sustain the zones.[25] (Figure 8) These zones are expected to be models that showcase a livable urban environment with a robust infrastructure.

There are many important lessons to be learnt from Tokyo by other Asian mega-cities. Understanding that Tokyo is still developing its risk management measures, each city's risk management measures can be reviewed using the four categories above and the level of their performance could be compared with Tokyo's. Comparative analysis will reveal the strength or weakness of each measure, and then people can discuss what policies should be implemented as a result.

The scope of risk management in cities seems to be expanding these days with




Source: Headquarters of the Governor of Tokyo, Tokyo Metropolitan Government

**Figure 8** Comprehensive Special Zone Area designated by the National Government and Tokyo Metropolitan Government

the attention being given to global climate change and diverse social conflicts. Since the mega-cities are frequently regarded as the major urban platforms for sustaining the world's economy over the next few decades, contemporary risk management policies need to be updated progressively since we are located in a place in which we co-exist with disasters.

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**Notes**

1 The Earth Institute, Columbia University, The Growing Urbanization of the World, March 8, 2005.
2 United Nations, World Urbanization Prospects: The 2011 Revision Population Database. http://esa.un.org/unup.
3 PricewaterhouseCoopers, Global City GDP Rankings 2008–2025. http://www.ukmediacentre.pwc.com/Media-Library/Global-city-GDP-rankings-2008-2025-61a.aspx.
4 The Institute for Urban Strategies at the Mori Memorial Foundation has published comprehensive rankings of cities annually since 2008, and Tokyo has been ranked 4th until the latest publication.
5 Yoichi Funabashi, "Postmortem of Crisis in Governance," *Lessons from the Disaster* (2011), p. 222.
6 The Japan Meteorological Agency ranks the intensity of seismic shakes from 0 to 7. Levels 5 and 6 are divided into two grades, lower and upper, making a total of nine levels.
7 Interview with the Property Management Division, Mori Building, May, 2011.
8 Bureau of Ports and Harbors, Tokyo Metropolitan Government. http://www.kouwan.metro.tokyo.jp/yakuwari/takashio/shisetsu/gogan.
9 Ministry of Land, Infrastructure, Transport, and Tourism News Release, April 20, 2011. http://www.mlit.go.jp/common/000142505.pdf.
10 Ministry of Land, Infrastructure, Transport, and Tourism, Heisei 23-nenban Shutoken haakusho [2011 White Paper on the Tokyo Metropolitan Area].
11 Tokyo Metropolitan Government, Tokyo-to no kitaku konnansha taisaku no kihonteki kangaekata [Basic Concepts to Secure Stranded People in Tokyo]. http://www.bousai.metro.tokyo.jp/japanese/kitaku_portal/tmg/pdf/240113kitakukihon.pdf
12 The "Aneha scandal" over false earthquake resistance data for residential buildings had revealed a social problem. Many buildings were diagnosed as fatal with regards to seismic performance after having originally obtained certification under the Building Standards Act.
13 Hiroo Ichikawa, "The Earthquake in Tokyo," *Lessons from the Disaster* (2011), p. 112.
14 Residences as of 2008 announced by the Ministry of Land, Infrastructure, Transport, and Tourism. Elementary and junior high schools as of 2010 announced by the Ministry of Education, Culture, Sports, Science, and Technology.
15 Institute for Urban Strategies, the Mori Memorial Foundation, Global Power Inner City Index 2010 (2011), p. 28.
16 Taishin Net 2013. 05. 12. http://www.taisin-net.com/solution/taiseis_eye/87lvn700000157p5.html.
17 Mori Building News Release, March 7, 2013.
18 Mori Building News Release, March 17, 2011.
19 Tokyo Metropolitan Government, 2020-nen no Tokyo [Tokyo of 2020] (2011). http://www.chijihon.metro.tokyo.jp/tokyo_of_2020/index.html.
20 Takayuki Kubo, The Remaking of Tokyo, *Urban Intelligence No. 4* (2012), p. 19.
21 Tokyo-eki shuhen bousai tonarigumi [Neighborhood Community Association around Tokyo Station for Disaster Management]. http://udri.net/tonarigumi/indextonarigumi.htm.
22 Central Disaster Prevention Council of Japan, February 2005.
23 Four phases defined by the US. National Governors Association in 1978.
24 Hiroo Ichikawa and Takayuki Kubo, *Tokyo no mirai senryaku* [*The Future Strategy of Tokyo*], p. 133.

25 Tokyo Metropolitan Government, Tokyo's Special Zones for Asian Headquarters. http://www.chijihon.metro.tokyo.jp/ahq_project/index.html.

## References

Funabashi, Y., et al. (2011). *Lessons form the Disaster: Risk Management and Compound Crisis presented by the Great East Japan Earthquake* (Y. Funabashi, & T. Takenaka, Eds.). Tokyo: The Japan Times.

Ichikawa, H., & Kubo, T. (2012). *Tokyo no mirai senryaku* [*The Future Strategy of Tokyo*]. Tokyo: Toyokeizai shimposha.

Institute for Urban Strategies, The Mori Memorial Foundation. (2012). *Global Power City Index 2011 YEARBOOK*. Tokyo: The Mori Memorial Foundation.

Institute for Urban Strategies, The Mori Memorial Foundation. (2011). *Global Power Inner City Index 2010*. Tokyo: The Mori Memorial Foundation.

Japan, Ministry of Land, Infrastructure, Transport, and Tourism. (2011). *Heisei 23-nenban Shutoken haakusho* [*2011 White Paper on the Tokyo Metropolitan Area*].

Kubo, T. (2012). *The Remaking of Tokyo, Urban Intelligence No. 4*. MIPIM Worldblog. Website by: http://blog.mipimworld.com.

Kubo, T., & Miwa, Y. (2011). *Higashi Nihon daishinsai ni miru Value of Tokyo* [*Value of Tokyo seen in the Great East Japan Earthquake*]. Tokyo: Global Security Research Institute, Keio University.

Nakabayashi, I. (2011). *Anatano toshini jishin ga kitara doushimasuka?* [*What would you do when earthquake hits your city?*]. Tokyo: Magazine House.

Nakabayashi, I. (2012). *Daijishin anatano machino Tokyo kikendo map* [*Risk in your city by earthquake in Tokyo*]. Tokyo: Asahi shuppansha.

Smith, K. (2013). *Environmental Hazards: Assessing Risk and Reducing Disaster, 6th Edition*. London: Routledge.

The Earth Institute, Columbia University. (2005). *The Growing Urbanization in the World*. Columbia University. Website by: http://www.earth. columbia.edu/news/2005/story03-07-05.html.

Tokyo Metropolitan Government. (2011). *2020-nen no Tokyo* [*Tokyo of 2020*]. Website by: http://www.chijihon.metro.tokyo.jp/tokyo_of_2020/index.html.