The Great East Japan Earthquake of March 11, 2011

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We are civilian volunteers for the Los Angeles Fire Department Auxiliary Communications Service (ACS) and we are Amateur Radio emergency communicators. We are not emergency planners nor are we familiar with the emergency plans of the LAFD or the City of Los Angeles. We were asked to do this study by Los Angeles Fire Department Battalion Chief Randy Beaty to help prepare for an event of similar magnitude here in North Hollywood in the San Fernando Valley, Los Angeles, California.

Background

The Great East Japan Earthquake, as it is named by the Japanese, was extraordinarily devastating to a country long used to and well prepared for natural disasters. By studying what happened in this Japanese event, we may better prepare for a disaster of similar scope in the Los Angeles area, and specifically here in the San Fernando Valley. Our earthquake geology may differ from the tectonics of Japan, but the chance we may experience a major earthquake of similar, or larger, magnitude, is just as great.

Izumi Aizu, from the Institute for InfoSocionomics at Tama University reports:

> *On 11 March 2011 at 14:46 p.m., an unprecedented earthquake hit the eastern half of Japan. In less than ten minutes, the first waves of a tsunami arrived on a scale that no one in Japan ever dreamed of. The magnitude of the earthquake was first said to be 8.4 and then changed into 9.0 on the Richter scale, the largest in the recorded history of Japan and the fourth highest in the world.*
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> *Japan is well known as the land of natural disasters, not only for earthquakes and tsunamis, but also typhoons, landslides and volcanic eruptions. All these happen frequently in any part of the archipelago. The central and local governments have disaster management divisions, armed with heavy equipment and conducting regular exercises. We thought we were prepared. Unfortunately, that was not the case this time.*
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> *To be fair, almost no one expected that an earthquake of this scale and magnitude would occur. There were predictions and warnings of a large earthquake within the next 30 years, but most expected less than 8.0 on the Richter scale. The Kobe earthquake in 1995, which killed more than 6,400 citizens, had a magnitude of 7.3. Simply put, the preparation was far less than needed.*
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> *The maximum reach of the tsunami was more than 40 metres above sea level – at least three to four times higher than most experts had anticipated. Successive waves of seawater washed away almost everything within one to six kilometres from the coastline, affecting over 30 cities and towns in six prefectures, spanning*

more than 500 kilometres along the coastline. As of 5 August, the death toll had reached 16,050-plus, and the number of missing more than 7,780. A total of more than 23,800 people were killed in the end, the highest loss from any disaster since World War II in Japan.

The tsunami also hit the Fukushima Daiichi nuclear power station and destroyed the regular and emergency cooling systems. On 12 and 13 March, explosions occurred at three of the four units due to the high temperature of the reactor's core, and a huge amount of nuclear contaminants were released into the air. More than 200,000 citizens inside a 30-kilometre radius from the nuclear station evacuated with bare minimum belongings, hoping to return within a few days. They were still in shelters and temporary houses or staying with friends and relatives after four months.[1]

Japan is a 'Ring of Fire' country where earthquakes are common and major earthquakes happen with some regularity. But no one ever thought an earthquake or a tsunami of the magnitudes experienced in March 2011 were possible, even though there were historical records of similar Tsunamis. Japan has one of the strictest construction codes and the physical damage caused by the initial earthquake was limited. However, the earthquake triggered tsunami waves which caused much of the devastation.

A report from the Disaster Prevention Research Institute, Kyoto University, states:

… The influence exerted by the seismic event itself was not so striking. Only one prefecture was impacted with a seismic intensity of VII, and eight prefectures were impacted with a seismic intensity greater than VI… But the losses incurred by the earthquake and tsunami together were extremely severe. According to statistical data from the Japan National Police Agency…, by April 13, there were in total 13,392 people dead nationwide and 15,133 missing. More than 335,000 refugees in northeast Japan are lacking in food, water, shelters, medical care, and even the necessary means to conduct funerals for the deceased.

Impact on Buildings

Up to April 3, there were 190,000 buildings damaged, among which 45,700 were totally destroyed. The damaged buildings in Miyagi, Iwate, and Fukushima were 29,500, 12,500, and 2,400, respectively (NHK World 2011). By April 13, the number was further verified by the Japan Police Agency and increased. About 250 million tons of rubble and debris were produced in Japan because of the earthquake and tsunami disaster.

Impact on Key Infrastructures

Several nuclear power plants and thermal power plants were heavily damaged in this disaster and details will be elaborated later in this article. The power supply of the Tokyo Electric Power Company (TEPCO) was reduced by 21 GW,

[1] Izumi Aizu Institute for InfoSocionomics, Tama University; Information Support pro bono Platform (iSPP) Website: http://www.ni.tama.ac.jp http://giswatch.org/en/country-report/social-mobilisation/japan

causing outages for 4.4 million families in eastern Japan (Japan Times 2011; The Nikkei 2011). From March 14 to March 29, TEPCO implemented rolling blackouts in most areas of Tokyo. Meanwhile, with the support of Tokyo residents' power-saving activities and temporary supply from steel manufacturers' power plants, rolling blackouts are expected to be avoided throughout this summer (Japan Ministry of Economy, Trade and Industry 2011).

The quake severely affected Japan's transportation system. After the quake, all ports in Japan were closed for a short time, and the 15 ports impacted by the disaster were not fully reopened until March 29 (Nihon Keizai Shimbun 2011). Because of the quake, the northeastern part of the Tokaido Shinkansen high-speed rail line was shut down and not reopened to the public until March 24 (The Guardian 2011). Sixty-two of the 70 railway lines run by the East Japan Railway were affected to various degrees, and 23 railway stations and seven lines were completely destroyed (NihonKeizai Shimbun 2011). The Sendai airport incurred massive losses because it was attacked by the flood caused by the tsunami one hour after the quake. Both Tokyo's Narita and Haneda airports were closed for about 24 hours (The Aviation Herald 2011).[2]

Fire Service

Masafumi Hosokawa, in the IEIC Global Newsletter Vol 35_4 reports:

At some dangerous facilities such as oil refineries and petrochemical plants, oil spill[s] took place and refineries and plants were set on fire. In some coastal areas of Iwate and Miyagi Prefectures which were hit by the tsunami, large fires spread over for long hours to reduce towns to ashes. …

The following pieces of eyewitness information were obtained: "a boat drifted by the tsunami wave upon the quay caught fire, then the fire spread over to the rubble and debris created by the tsunami and to surrounding forests and fields," "the rubble and debris created by the tsunami began to burn when swept into the sea. I saw flames moving riding on the waves," "fire engines started fire-fighting but extinguishment was not achieved because fire cistern was emptied soon," and so on.

These testimonies indicate that fire engines could not come up to the fire scenes because of obstacles such as rubble and debris and flooding caused by the tsunami. This is a very important issue of fire-fighting and rescue activities in case of tsunami disaster. Countermeasures are required.

Large fires, each spreading over a wide area, broke out in many locations… Most of these fires reportedly originated from houses destroyed by the tsunami and/or sweptaway cars, ships, etc. Some of them continued burning for three consecutive days…

[2] http://www.springerlink.com/content/d762447n85m41115/fulltext.pdf

Some volunteer fire fighters became the victims of, or otherwise suffered from, the tsunami. Also, town offices and fire department buildings in various municipalities in the disaster areas were badly damaged by the tsunami. A survey of damage and inundation was conducted in Kamaishi, Otsuchi, Ishinomaki, etc. focusing on town offices and fire station buildings.

There were a lot of volunteer fire stations in the areas inundated by the tsunami. The difficulties we face during fire fighting and rescue activities when attacked by a great tsunami, and resulting problems to be solved, were verified during the field reconnaissance. These observations clearly showed that the fire stations and volunteer fire stations were either completely destroyed or washed away by the devastating tsunami wave exceeding 10 meters in height (of course, fire engines and firefighting equipment were totally swept away)...

The disaster was so enormous that [the] local fire fighting force could not response to all disaster site[s]. The Fire and Disaster Management Agency (FDMA) dispatched relief team named "Emergency Fire Response Teams (EFRT)" mobilized from outside of affected prefectures. Total 28,620 firefighters, 7,577 units were dispatched to the affected area. (783 of 798 fire departments and 4,354 units were registered to the EFRT as of April 2011.)

The FDMA needs actual damage information of the struck area to determine where rescue teams must be dispatched, and communication systems of information sharing between the headquarters and disaster site, for an effective relief operation. The Satellite-based communication system provided by "the Local Authorities Satellite Communications [http://lascom.or.jp/]," played a big role to gather damage information from the local governments in the disaster site.[3]

The Role of the Military

Even before it was apparent that the local fire firefighters would be unable to respond, and before regional mutual aid could be organized, both the Japan Self Defense Force (JDSF) and the US Military in the country of Japan prepared to deploy. The JSDF forces and assets are located in country and are in position to respond to natural disasters. They have standing orders to deploy immediately in disaster situations and play a major role in the response and recovery operations. The US Military also had significant forces and assets in the area, had trained with the JDSF, and responded quickly.

Lyule Mizokama, a translator for “Japan Security Watch” reports from an article titled:

“Disaster Relief Operations of the JSDF for the Great East Japan Earthquake”, published in the magazine “Sekai no Kansen” (Ships of the World), June 2011. The

[3] The Disaster Caused by the 2011 Great East Japan Earthquake and Fire Fighting Operation , Masafumi Hosokawa http://www.ieice.org/cs/gnl/gnl_vol35_4.pdf

article was written by Hidemichi Katsumata, chief of the editorial board, the Yomiuri Shimbun. Excerpts from the translation follow:"

> *On March 11th, after 3 p.m., 15 minutes after the earthquake occurrence, the North East Army, the Japan Ground Self-Defense Force (JGSDF) (headquartered in Sendai-city) sent its reconnaissance helicopters from nearby Camp Kasuminome to the disaster sites and had JGSDF liaison staff dispatched to municipalities in Miyagi and Iwate Prefectures that requested Disaster Relief Dispatches…*
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> *At that moment, a high tidal wave warning was issued and an evacuation order was released in Matsushima Air Base of the Japan Air Self-Defense Force (JASDF) in Matsushima City, Miyagi Prefecture. This air base was facing the sea. "A tsunami is coming. Evacuate to the third floor of the building!" Soon after this, a tsunami surged onto runways and hangers as if the water was swallowing the facilities. Wood drifting in the water came over the submerging runways, and 18 of two-seated F-2B, training fighter jets that cost approximately 12 billion yen each, and 28 other aircraft including UH-60 rescue helicopters inside or in front of hangers, were instantly sunk. Some airplanes were pushed 300 meters along by tsunami. Moreover, the first floor of the main building and electric source facility and computers of the control tower were all destroyed. Matsushima Air Base lost most of its functions.*
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> *After 3:30 p.m., an escort ship Harusame departed as the first dispatched ship from Pier Yoshikura in Yokosuka. Harusame left with its peculiar metallic sounds. By around 10:00 a.m., 17 ships in port left for the disaster site. Among these ships, a supply vessel Tokiwa, which was in port during its training period, received an order to deliver an emergency cargo shipment. At 9:30 a.m., the Tokiwa left loaded with prepositioned emergency food such as about 95,000 can food, 14,200 meals of bread, 1,050 blankets, searching equipment such as electric saws, and portable toilets.*
>
> *Soon, the Self-Defense Forces faced the situation that they never imagine before. They gradually understood that damaged areas were hugely widespread when they received information from the JGSDF helicopters and the JASDF's RF-4 jet reconnaissance planes (Hyakuri Base, Ibaraki Prefecture). However, there was no concrete information to decide to which disaster areas the JSDF forces should be first deploy for searching and rescue activities because the municipalities' communication systems were also destroyed and so were totally disconnected.*
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> *Previously, on October 2008, the North East Army, Japan Ground Self-Defense Force (JGSDF), conducted an earthquake exercise, "Michinoku ALERT2008," presupposing that "M8.0 earthquake, centered off the coast of Miyagi Prefecture, occurred, and then tsunami attacked off the coast of Sanriku, causing scores of casualties and victims." This exercise was as a large-scale exercise with a total of 16,000 people participants from 22 cities and towns off the coast of Sanriku and 35 related agencies and organizations such as the Japan Red Cross Society*

and the Tohoku Electric Power Co., other than JGSDF, JASDF, Iwate Prefecture and Miyagi Prefecture. During the disaster drill, the JGSDF sent its units. The JGSDF's disaster prevention operations were based on the premise that most of information were provided by the victim municipalities.

"In the Great East Japan Earthquake, many town halls were destroyed by tsunami and the damage of each place was too immense so that the functionality of the municipal government itself was gone. The precondition to deploy units based on information from afflicted areas was collapsed," said a GSDF staff member. Given this situation, the JGSDF immediately had about 20 helicopters departed…

The helicopters were sent to get a grasp of the damage and rescue residents who were isolated on roofs and other places as soon as the helicopters found them during their survey from the sky. "We just rescue when we find them from the air. It was not only municipal governments that had lost access to information, but the police and fire departments as well. We had to continue rescue operations by gathering information by ourselves." (Said by a JGSDF staff member.) The rescue helicopter units entered the sites based on self-gathered information and they had to wait until dawn to start a full-scale mobilization of rescue activities.

Moreover, there was a lot of wood drifting in the water filling the ports of Souma (Fukushima Prefecture), Sendai, Miyako (Iwate Prefecture), where the JMSDF ships were supposed to unload emergency goods. Because of this condition, large ships could not come along the piers because cars and trucks were also sunk and it changed the water depth. "We could only transport goods by shuttle between supply vessels off the coast and the land, after fully mobilizing ship-borne helicopters and also launching helicopters from Tateyama, Chiba Prefecture," according to a JMSDF staff member. The largest disaster relief operation of the JMSDF in its history had just started at that time, but another crisis [the Fukushima Nuclear disaster] was already getting close.[4]

A report titled "Japan 2011 Earthquake: U.S. Department of Defense (DOD) Response" states that:

With almost 40,000 U.S. troops stationed in Japan, the situation was unique in that U.S. forces and associated resources were located in close proximity to deal with the crisis. All services – Army, Navy, Marine Corps, and Air Force – are present in Japan in various capacities. In addition, U.S. forces train regularly with their Japanese Self Defense Force (SDF) counterparts, including many humanitarian assistance and disaster relief exercises.

With over 100,000 SDF troops called up to respond to the disaster, U.S. forces were able to coordinate their efforts almost immediately to provide support for the Japanese responders. Within 8 days of the earthquake, the SDF had deployed 106,200 personnel, 200 rotary aircraft and 322 fixed-wings, and 60 ships. Nearly

[4] Tohoku Earthquake: The SDF and the First 24 Hours http://newpacificinstitute.org/jsw/?p=6375

> *all of the Maritime SDF ships were transferred to the affected area, and forces from the southernmost to the farthest north territories were mobilized. After rescuing nearly 20,000 individuals in the first week, the troops turned to a humanitarian relief mission in the displaced communities, in addition to supporting activities at the troubled nuclear reactors.*[5]

The JSDF has standing orders to deploy during disasters and pre-positioned forces and assets were immediately available, though transportation and communication issues were a problem. Because of the special relationship of the US Military and Japan, the high number of US military assets located near the earthquake and tsunami sites, and joint disaster relief training, both organizations were able to respond quickly.

Should a similar earthquake take place in the United States it is doubtful if local responders could count on such a rapid military response. The Unites States has a much larger area, a lower concentration of troops and supplies in local areas, and less frequent (if any) joint training between the military and emergency responders in many areas. Many of our military assets and supplies are located overseas, including Japan. Transportation systems into and out of the Los Angeles area, including rail lines, freeways, and harbors, could be seriously disrupted causing significant additional delays to incoming military aid.

International Involvement

The Kyoto University Report continues:

> *After the quake, Japan specifically requested quake rescue teams from Australia, New Zealand, South Korea, the United Kingdom, and the United States (Nebehay 2011). It also requested satellite images of available types of the quake and tsunami regions according to the International Charter on Space and Major Disasters.*
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> *By March 30, 134 countries and regions and 39 international organizations had expressed their willingness to provide aid to Japan. Twenty-three countries and regions sent out rescue teams and experts on nuclear accidents. The statistical data released by the Narita branch of Tokyo Customs on March 29 showed that, in total, 190 batches and 1300 tons of relief goods from 29 countries and regions arrived at Narita Airport between March 12 and 25. Of these 190 batches, 60 were from China, 40 from the United States, 30 from Thailand, and 20 from Korea. The major types of goods included food, blankets, mineral water, radiation protection suits, and emergency lamps. By April 3 the Japanese Red Cross had received over one billion USD in donations in response to the disaster, and dispatched more than 200 emergency relief teams to the disaster zone.*[6]

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[5] Japan 2011 Earthquake: U.S. Department of Defense (DOD) Response http://www.fas.org/sgp/crs/row/R41690.pdf

[6] http://www.springerlink.com/content/d762447n85m41115/fulltext.pdf

Communications

In addition to the massive life and property damage, the local communications infrastructure in the affected areas was destroyed.

Izumi Aizu again:

> *Information plays a critical role in organising rescue, relief and reconstruction work for all social disasters. The so-called Great East Japan Earthquake was no exception. Yet the very information badly needed by the citizens in devastated areas was not available in the aftermath.*
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> *It is perhaps one of the first massive disasters that hit a well-developed country equipped with broadband and 3G mobile networks and other information and communications technology (ICT) infrastructure and services. Many citizens were using the internet and smartphones in addition to the conventional mass media such as TV and radio broadcasting to find information or call for rescue. However, most telephone lines where inaccessible. Given the massive call demand from people immediately after the quake, telephone operators blocked 90% of calls in the most devastated areas – a standard practice to ensure that critical connections, such as those used by emergency services, could be made. However, this also meant that many citizens could not talk to their families and friends for hours, and even days in some areas.*
>
> *In coastal areas, the tsunami waves destroyed most physical infrastructure – roads and railways, telephone and power lines and radio towers. These areas became "information black holes" and that continued for a week to a month or even longer.*
>
> *The government rescue team had 1,500 radio and satellite mobile phones and other communication devices. But these did not meet the demand for communication, and many could not be delivered to local governments, whose city halls and buildings had been severely damaged or lost. Many people tried to use Twitter, email via mobile phones, social networks such as Facebook or Mixi (a popular service in Japan) to ask to be rescued, for food, medicines or blankets – and some of these messages reached people outside the affected areas who managed to provide the relief needed in time.*[7]

Fumiyuki ADACHI, IEICE Fellow Tohoku University, Sendai concludes in a report from the Japanese IEICE Communications Society concludes:

> *…the communications networks could not demonstrate their potential when facing the disaster. Communications cables and equipment were seriously damaged by the earthquake and the succeeding tsunami and furthermore, many base stations of cellular phone networks lost their power supply. Moreover, a vast amount of call requests poured into survived networks resulted in a very low probability of call success… During the first few days after the disaster, the first*

[7] Izumi Aizu Institute for InfoSocionomics, Tama University; Information Support pro bono Platform (iSPP) Website: http://www.ni.tama.ac.jp http://giswatch.org/en/country-report/social-mobilisation/japan

> *priority should be given to emergency communications and voice communications. We need a communications network that can flexibly allocate available network resources between real-time voice services and broadband multimedia data services.*[8]

We think most emergency communicators would agree with Mr. Adachi that real-time communications are important, but would suggest that life safety emergency and priority communications should have precedence over health and welfare messages.

A report from the Japanese Amateur Radio League (JARL) says that in the damaged areas of Fukushima Prefecture, Iwate, Miyagi Prefecture, the fixed telephone lines, cellular systems, and public networks ceased to function. The damage was severe and all day-to-day functions failed, leaving the survivors unable to fully grasp the reality of their situation. The JARL operated an emergency communication information gathering net and began compiling reports from the few amateur radio operators in nearby areas that were still able to function and found that Twitter messages became an important source of information. JARL found it necessary to continue their amateur radio and twitter activity until the end of March, approximately seven weeks after the initial incident.[9]

Jai-Ho Oh, PhD., Professor, Department of Environmental and Atmospheric Sciences, Pukyong National University, in "A Consideration for the better Preparedness against Mega Disaster: Lessons from the 2001 Great Eastern Japan Earthquake and Tsunami" reports:

> *…the biggest problem was the reliability of twitter updates, particularly in calls for help, that were misplaced, or lies. Worryingly, they also found numerous unreliable "retweets" (RTs), where users of the service repeated inaccurate information and that this was one of the biggest information-related problems facing those involved. However, Twitter communication could be improved if official hashtags were announced during disasters and the number of retweets for a given hashtag could be limited to avoid the wider spread of disinformation.*
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> *According to Acar and Muraki (2011) there are three major conclusions. First, all users should have more responsibility for their tweets. Secondly, everyone should realize that Twitter is a public communication tool. Thirdly, information sources should be made clearer in updates. They add that appropriate use of hashtags and a method for regulating inappropriate or false retweets might be implemented.*[10]

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[8] Successful Recovery from 3.11 Great Tohoku Earthquake Disaster, Fumiyuki ADACHI, IEICE Fellow Tohoku University, Sendai http://www.ieice.org/cs/gnl/gnl_vol35_4.pdf

[9] http://translate.google.com/translate?hl=en&sl=ja&tl=en&u=http%3A%2F%2Fwww.jarl.or.jp%2F

[10] http://scholar.google.com/scholar?start=50&q=%22Emergency+Response%22+%2B+Japan+%2B+Tsunami+%2B+2011&hl=en&as_sdt=0,5

Risk.net reports:

> *1,300 out of 7,900 [mobile base stations] initially affected remained offline by April 21. [Ten days after the earthquake and tsunami] Another limit to voice communications: if power remains down for more than a day or two, mobile phone handsets will start to run out of battery life, and merely restoring power to a base station (with, for example, a mobile generator) will not necessarily restore communications*. [11]

Izumi Aizu again:

> *The stories we heard were horrible, to put it lightly, especially in coastal cities. When we arrived there [to help with additional communications], we lost our voices. We just could not imagine what to say. Then, one finds oneself challenged. You must say something. You must act.*
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> *Homes that were washed away and ended up at the foot of a hill where we stayed at my friend's house. No search and rescue operation had been performed there yet after three weeks, on 3 April 2011…*
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> *Later, in early April, when we organised a field visit to the Tohoku region, including the cities of Iwaki, Sendai, Natori and Kesen'numa, to see what exactly happened, many people we met told us stories that were different to those we had heard in Tokyo, confirming our expectations. These were some of their comments:*
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> *"None of the digital or analogue media worked at all."*
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> *"Mobile phones were just useless. I tried to call my family members to find out if they were okay. But it didn't connect. When we got through, busy signals were the answers."*
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> *"Eventually we lost battery power. Since the main power lines were totally down for days, we could not recharge the power, and so within a few hours, we lost it."*
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> *"TVs? Come on! When there is no electricity, how can you get to see the TV programmes?"*
>
> *"Twitter? Facebook? You are kidding! We were simply not in that mode. Just stunned by the horrible situation; watching the tsunami waves, could not do anything."*
>
> *To be fair, all the stories, both about what happened in Tokyo and what happened in Tohoku, were largely true. But they were just many tips of a large iceberg, we felt…*
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> *It is said that up to 72 hours is the most critical period to save the lives of people affected by disasters. Yet as the survey shows, most information channels were*

[11] http://www.risk.net/operational-risk-and-regulation/feature/2111999/lessons-japan-communication-key-business-continuity#ixzz1q9ogjULs

not functioning sufficiently during this time. It was extremely difficult to determine the exact degree of damage in the coastal areas, which span 600 kilometres. The police, army and fire and rescue departments all dispatched the first emergency teams, but we knew that the communication lines became more dysfunctional as you approached the affected areas.

It was only in late April, after more than a month, when most major telecommunication operators announced that the repair work on their trunk lines and telephone services was almost done.

Many people we interviewed emphasised the importance of power supply in an emergency situation. As we have entered the digital age, almost all devices and services are designed to use electric power. But that could become the major source of vulnerability once a large-scale natural disaster hits a technologically advanced society. ICTs [Information and Communication Technology] can only work when a sufficient supply of electricity is guaranteed.

Of course, super-large-scale natural disasters such as the 9.0 earthquake or a massive tsunami could destroy almost all manmade infrastructure and devices/equipment once it hits land. However, there are always areas outside the devastated areas where people could start to do rescue and relief work. They can bring in resources needed. This time, what we found was a lack of preparedness for organising the rescue work using ICTs.

Though we have benefited much from the use of the latest technologies and services such as Twitter, Facebook, YouTube, to name a few, no well-structured information-sharing mechanisms were ready. At best, it was ad hoc.[12]

More from the Disaster Prevention Research Institute Report:

In Japan there are various ways for the public to get access to disaster information—by mass media and cell phone services, for example. The Japanese media have developed a rapid and systematic reporting system for disaster situations, and will promptly disclose all kinds of useful information whenever a natural disaster occurs. Japan also invests heavily in public disaster education, making one of the highest disaster risk aware populations in the world. With the help of disaster preparedness training carried out in communities, the Japanese people have developed the skills and habits of self-relief.

Several issues regarding the governance of large-scale disaster risk arise from the experience of the Eastern Japan Great Earthquake Disaster.

(1) The severity and unexpectedness of large-scale disasters require a global, synergic, and efficient response system. The response needs to mobilize all available resources, from public and private sectors, affected and unaffected areas, domestic and abroad. The response needs to highly coordinate all disaster response entities so that the synergic effect is achieved. The response

[12] Izumi Aizu Institute for InfoSocionomics, Tama University; Information Support pro bono Platform (iSPP) Website: http://www.ni.tama.ac.jp http://giswatch.org/en/country-report/social-mobilisation/japan

must be founded on rational strategies with orderly and efficient arrangements based on the emergency plans. In this sense, centralized power in the face of large-scale disasters is indispensible.

(2) The regionalized and globalized impacts of large-scale disasters call for a new international platform to cope jointly. The recent experiences of catastrophes worldwide imply that the impact of a catastrophe is no longer confined to the affected areas but spreads around the world in the context of globalization. The mismanagement of the affected countries will bring about serious consequences for the surrounding countries or even the whole world.

The radioactive contamination caused by the nuclear accident following the earthquake and tsunami is affecting the rest of the world through atmospheric circulation. The polluted water released by the Tokyo Electric Power Company is likely to affect the entire Pacific Ocean in the coming decades. In the long term, impacts of radiation should be carefully monitored and assessed based on data derived from previous nuclear accidents and state-of-the-art medical knowledge. International frameworks are required to do so.

The Japanese economic instability caused by the quake affects the yen and Japan's domestic economy, which draws attention from the G7 (Group of Seven) that is already planning to intervene against the yen when necessary. Moreover, the existing international framework of humanitarian aid cannot meet the demand of coping with large-scale disasters. A mutual assistance system that incorporates a higher degree of international involvement in coping with large-scale disasters should be established.

(3) The complexity of the catastrophic impact urges us to conduct further studies on multi-hazard and disaster-chain issues. Due to the super-energy released in the catastrophe, many regional physical-geographical factors are likely to cross critical thresholds of balance and create secondary hazards, which will transmit and enlarge the disaster in the form of disaster chains to an extent beyond regional endurance. In the 2008 Wenchuan Earthquake in China, for example, the quake generated a huge amount of loose soil and rocks, inducing landslides and debris flow. In the Eastern Japan Great Earthquake Disaster, what mattered most was not the quake but the tsunami as well as the nuclear crisis that it triggered. The chained-triggering phenomenon is similar to other catastrophes in recent years. It is also a critical reason that large-scale disasters generally claimed huge losses. Therefore, it is necessary to study the formation mechanism of disaster chains and issue region-specific precautions against potential disaster chains.

(4) Key infrastructures require more robust systems planning and design. Here key infrastructures refer to those that can largely facilitate disaster relief efforts, for example, life-line projects and transportation hubs, or those that create serious threats, such as nuclear power plants and major water dams. Failure of a key infrastructure would lead to the failure of an entire system. In most cases problems only need to occur in one or several small but critical components. The

> *power supply for the cooling system is only a subsystem of the Fukushima power plant, but its failure collapsed the entire system and was fatal.*[13]

LAFD Firefighter III and Auxiliary Communications Services Operations Officer Michael Horst states that Captain Rich Atwood was deployed to the Japan earthquake. Captain Atwood reports that he did not significantly interact with the local fire departments, but says by the time he arrived in Japan it appeared to him that at least some of their higher communications were working. He attributes this to the fact that many of their repeater sites and infrastructure were on higher ground and the waves did not wash them away. Some communication sites had battery and backup generators and microwave hops to bring the signals back to the dispatch centers. Japan primarily uses a UHF radio system for its communications.

He also stated there was some cell phone coverage and it depended on where the sites were located whether the phones would work or not. When the international USAR teams arrived they deployed portable repeaters to support their operations only.[14]

Summary

Japan experiences earthquakes, landslides, typhoons and volcanic eruptions on a regular basis and has well trained and equipped disaster response teams, including the automatic deployment of the Japanese military.

The Japanese citizens are well trained in disaster self relief down to the lowest levels.

Earthquakes and other natural disasters greater than the largest imagined and prepared for can and will happen. The Great East Japan Earthquake and Tsunami of 2011 was such an event. Even trained responders were not prepared for and had not anticipated the total destruction of all local infrastructure and governance.

You can never be too well prepared for a large scale disaster.

Large scale disasters require a global response system.

Local government facilities were destroyed and government and community leaders were unable to respond or participate in the damage assessment and relief requests. Incoming responders had to rely on their own observations for intelligence and their own leadership and protocols for direction.

Search and rescue teams were overwhelmed by the devastation and some areas remained unsearched for weeks.

Water and basic supplies like shelter, blankets, power, and sanitation supplies were unavailable or in extremely short supply.

Local and regional communications were destroyed and no well structured information systems remained. Surviving citizens received very little information regarding the

[13] http://www.springerlink.com/content/d762447n85m41115/fulltext.pdf
[14] Email from Michael Horst, LAFD ACS Operations Officer, to Jonathan Zimmerman, April 4, 2012

severity of the situation for days. Those that had some cellular phone service were able to send and received text messages while they still had battery, but many of the messages to and from the affected areas were incorrect or unreliable. Satellite phones distributed to the incoming responders helped, but were inadequate to handle the need for communications.

By the time International responders arrived, some higher level communications in the region were working.

How could this apply to Battalion 14 and the San Fernando Valley?

The City of Los Angeles may be better prepared than many American metropolitan areas, but may not be well prepared for a major, regional, emergency such as an earthquake approaching the magnitude of the Great East Japan Earthquake of 2011. Basic, immediate life sustaining supplies such as drinking water may be in short supply. Critical shortages may, in some areas, cause civil unrest as those who are unprepared and desperate try to obtain supplies they need to survive. Those who are prepared may be unwilling to share.

The citizens of Los Angeles have come to expect the Los Angeles Fire Department to respond when they need help and the LAFD has, through training and efficient use of resources, has always been able to do so. That's not going to happen when we get the Big One. Many residents haven't thought this through and are totally unprepared. We need to continue to educate our citizens on the need to provide their own self-relief for the time it takes for the professional responders to arrive in their neighborhoods – a time that could be several days, or more.

When we get the Big One, it may be bigger than we've been lead to expect. Even though the East Coast of Japan had historically experienced Tsunamis similar to the one in 2011, no one thought it would happen there again and they were not prepared for it. We know our earthquake is coming and know it may be a big one – we just do not know how big. Or when. Other disasters, such as terrorist acts, radiological disasters, industrial spills, chemical or biological events, epidemics, and powerful weather events are possible, may be bigger than we anticipate, and should be carefully planned for.

A recent estimate of the Big One for the San Andreas Fault is one of magnitude 8.1.[15] Modern building codes are designed to produce buildings that are survivable with some degree of ground motion. What happens if it's larger? What happens if it's a 'wall-to-wall' earthquake that reverberates back and forth between the Santa Susanna and Santa Monica Mountains and turns San Fernando Valley floor into Jell-O? What happens if the San Fernando Valley experiences something approaching the 9.2 magnitude Alaska Earthquake of 1964?

Transportation conduits into the San Fernando Valley may be damaged and impassable. Interstates may be closed by downed bridges and collapsed roadways, canyons may be closed by fires, landslides and debris, airports may be unusable, and

[15] http://articles.latimes.com/2010/oct/10/local/la-me-san-andreas-20101010

local roads may be clogged by downed overpasses, downed power lines, and rubble. Dams and reservoirs may be breached sending valuable water resources downstream causing additional damage.

It will be difficult to move responders and supplies into and around the valley. If responders are coming from outside agencies and local landmarks and street signs are destroyed, how will they find their way around? GPS? Are we all using the same datums?

Even if it were possible to get responders and supplies into the San Fernando Valley from the Los Angeles Basin and elsewhere, Los Angeles may have experienced extreme disruption and require assistance as well, for all the same reasons. In addition, harbors, ports and airports may be destroyed or damaged and normal routes of entry impassable and jammed with debris. Railroad lines into and out of the Los Angeles region may be severed. Movement of supplies and responders into the region may be very difficult and take significant time. Lives that could have been saved may be lost.

Local communications may be destroyed, area communications heavily damaged and regional communications, if still working, will be clogged with non-essential traffic.

> *Most cellular phone systems are designed to handle only about 6-10% of their subscribers at any one time. This works well in normal situations and is economical for the company. But when a crisis happens, they quickly become overloaded as everyone (the other 90%) tries to talk at once.*[16]

This means at best, 90% of the cell phone users will not be able to access their system if they all try to call at once, even if the systems are functioning properly. Though some cellular providers such as Verizon are installing emergency power generators at their towers, most cell systems will probably fail after a disaster – if only from overuse. And working mobile phones will fail after their batteries are discharged.

It is possible that some satellite and regional commercial television and radio broadcast systems located outside the San Fernando Valley may survive, but if the power is out, television probably will not be a useful information device. Portable radios may work as long as their batteries hold out. If emergency managers are able to quickly assess a disaster, they may be able to provide remaining regional broadcasters with important information for the public.

The Los Angeles Fire Department has trained approximately 60,000 Community Emergency Response Team members since the inception of the program.[17] Some of those citizens will be prepared for disaster and will be able to help their families and their neighbors, but more trained citizens will be needed.
In the Japanese earthquake emergency responders came from all over the world, speaking dozens of languages. USAR teams came from 12 different countries,

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[16] Amateur Radio Relay League Emergency Communication Course, Topic 1
[17] Email from Captain Stacy Gerlich, LAFD CERT Administrator, to Jonathan Zimmerman, April 25, 2011

including USA 1 and USA 2. [18] How will we communicate with foreign rescuers if they arrive to help, and how will they communicate with us?

Suggestions:

Plan for a devastating event that isolates Battalion 14 from power, normal communications, and physical access.

Establish stockpiles of basic supplies – water, tarps, blankets, sanitation supplies, in protected areas near potential evacuation sites. Encourage citizens to store their own water, batteries, and other valuable and higher maintenance supplies.

Establish plans for communication to and from devastated areas. Amateur Radio operators, FRS/GMRS radio users, and the LAFD ACS-CERT Comm Plan could help if the communicators are properly trained and have emergency power.

Establish relationships with military and civilian emergency response agencies outside the region and coordinate communications systems and radio frequencies.

Establish relationships with specialized emergency response agencies including USAR teams and non-governmental organizations outside the country and plan on ways to communicate with them in their languages.

Continue to inform the public of the need for self-relief, disaster preparation and increase support for LAFD CERT Training. The CERT program was specifically designed by the LAFD to promote self-survival, self-relief, and local neighborhood based organization until professional responders can arrive. As citizens are trained and become more aware of the dangers we face, they may become more supportive of the Los Angeles Fire Department and the Department's plans to continue planning for disaster.

Develop robust and resilient regional communications systems that can function on self-sustained emergency power for a minimum of 72 hours.

Schedule and conduct joint training exercises with the LAFD Auxiliary Communications Service (LAFD ACS), the Los Angeles County Disaster Communications Service (LAC DCS), the Amateur Radio Relay League Amateur Radio Emergency Services (ARRL ARES), Los Angeles County REACT, LAFD CERT Amateur Radio Operators, and other interested local radio communication groups. Each of these agencies has their own specific mission, but should be able to communicate with each other provide situational intelligence and tactical messages to and from the Los Angeles Fire Department and the City of Los Angeles.

- end -

[18] http://www.mapaction.org/?option=com_mapcat&view=mapdetail&id=2334