Emergency Planning for Urban Waterfront Areas- For the Effective Disaster Management in First 48 Hours -

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［論文］

Emergency Planning for Urban Waterfront Areas

- For the Effective Disaster Management in First 48 Hours -

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Abstract: This study aims to examine methods of building disaster-resistant communities in urban waterfront areas through identifying and analyzing risk factors and mitigating factors through the case study of the September 11th terrorist attacks on New York City and the Great East Japan Earthquake on March 11th, 2011. This paper emphasizes that the results of constant vigilance and thorough preparation by local governments and members of the community are effective ways to ensure and establish efficient crisis management and resiliency in the face of disaster, focusing on the critical first 48 hours following a disaster, and detailing the most vital actions that authorities and citizens must take during that phase.

Key words: Emergency Planning, Urban Waterfront Area, GIS, Disaster-Resistant Community

Introduction

Immediately after a disaster, either natural or man-made, what first responders are eager to know is“What has happened?”, “Who needs help?”, “Where am I needed?”, and “What is needed to help people?”[1] Although these questions are essential to an effective response, no authority or agency can readily and precisely answer them in the initial phase of a crisis. More accurately, even first responders sometimes do not know to whom they should direct these questions, or, even if they know, it is not certain that they can communicate that information to their commanders at all.[2] This uncertainty only complicates the chaotic yet critical first 48 hours after a disaster, in which most of the injured can be treated and lives can be saved. Of course, we need to have an emergency plan in place for such a circumstance, but it must be borne in mind that a plan that is too detailed and complicated cannot be implemented well in an emergency.[3] Even though a plan cannot anticipate all scenarios, we nevertheless have a duty to prepare ourselves for these cases as best we can so that casualties can be minimized.

There are some instances in recent memory in which confusion in the aftermath of a disaster exacerbated its impact even though these disasters occurred in the most developed and well-resourced of countries. For instance, on September 11, 2001, because there was a lack of equipment for disaster relief and a breakdown of infrastructure, first responders in New York City had to use their own shirts to cover their faces while attempting to rescue survivors[4] and to buy bottled water with money from their own pockets to treat the injured. Today, these first responders who frantically tried to save as many people as they could are suffering from a myriad of health problems, particularly to the lungs, such as chronic bronchitis and even lung cancer, because of the lack of adequate protection during their missions. Obviously, they should be considered victims of the disaster as well. Reducing the number of collateral injuries caused to rescue workers must also be one of the pillars of disaster management.

Another example is the Great East Japan Earthquake of 2011, in which professional and volunteer firefighters who rushed to manually close the floodgates at the 30-minute interval between the earthquake and the tsunami died accomplishing their mission. Tragically, some arrived at gates which had already been closed by others without that knowledge because of a breakdown in communication. The death toll among those firefighters was 211. Furthermore, survivors of the tsunami themselves died from hypothermia because there were insufficient provisions such as food, blankets, and medications. These deaths could all have been avoided had there been an effective contingency plan in place.

Obviously, the first 48 hours, commonly referred to as Phase 1 to 2, is vital for disaster management. During this phase, much assistance is required, *e.g.* heavy machinery, from outside of the disaster zone for the rescue effort, so prompt and efficient logistics is crucial. The point to remember is that there is no ready-made emergency plan in existence that is clear, practical, and able to answer the questions asked at the top of the introduction. To minimize the number of casualties, it is crucial that we determine beforehand who must do what, in what manner, where, and when.

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Despite the difficulty, however, this paper will aim to create such a plan for an urban waterfront area through cooperation between the government, the private sector, and among the residents themselves, to build a disaster-resilient community. Since what we should do might change based on the circumstances both before and after the disaster, we need to specify what appropriate actions to take at what stage of our emergency plan. Therefore, it is needed to divide our plan into five steps: Identifying Risk Factors, Assessing Mitigating Factors, Disaster Preparedness, Emergency Response, and Recovery.

Dependent on the type of disaster, specific emergency responses have to be taken, so it is imperative to identify the potential dangers beforehand in order to respond more effectively and to make the management of the response easier. For example, firefighters should be able to locate sources of flammable substances in areas such as fuel tanks, gas drums, and chemical plants so that evacuation routes can be planned to avoid these points. Also, since the waterfront areas may be a danger in the aftermath of an earthquake because of the possibility of a tsunami, temporary shelters should then be built well away from the coast. A well-designed emergency plan should include some identification of risk factors.

Simultaneously, it is necessary to indicate some mitigating factors inherent in the area of a potential disaster zone. If the wind from the shore is generally humid at particular times, it might dampen the strength of a fire. Also, if there is a thoroughfare going through a ward, it might prevent the spread of the fire to neighboring areas. Finally, if a district has high ground, it might facilitate the residents' evacuation in the event of a flood. Knowing the mitigating factors will help planners to estimate more accurately at what level the impact of the catastrophe might possibly be.

To promote preparedness for a disaster, it is essential for first responders to be familiar with the locations of critical infrastructure buildings such as power plants, water works, communication towers, train stations, hospitals, schools, and police and fire stations so that they can figure out how they would coordinate their functions to search for and rescue any victims. Thus, after having identified the clear risk factors and potential mitigating elements, planners will be able to eliminate danger and better prepare themselves.

In turn, these three phases of the emergency plan should lead to quick and smooth access to the disaster scene and efficient response to search and rescue missions. With the knowledge from these phases, first responders can avoid danger areas and routes when carrying out their missions. They will have the necessary supplies ready at the stockpile locations.

The last consideration of our disaster management plan is recovery. Generally, recovery is examined from a long-term perspective, but the evacuees should get back to their ordinary lives as soon as possible. While it is true that indispensable supplies need to be distributed after the disaster, it would be even better if those affected could access those materials at local stores. This will also have the effect of returning a sense of normality, an important psychological benefit to those who have been traumatized, allowing them to gradually become self-sufficient again. This should be considered as the very first step of a real recovery.

Through the examination of these five steps, this study will help the community to be better ready to handle a catastrophe. We cannot force the population to evacuate from an area in times of disaster without their prior understanding and knowledge of the plan. The cooperation and coordination between the government, the private sector, and the community in all five steps is essential for the effective execution of the plan. For instance, the private sector often has a wide domestic, and sometimes even global, logistics network. In contrast, small municipal authorities might not be capable of operating fully in the case of a disaster when the entire man power is concurrently carrying out their duties and suffering as victims themselves. Thus, during recovery, the participation of the private sector will make it more efficient, especially in restoring the supply chain. Moreover, suppliers need to know where people should go and what is needed, so if we can anticipate the movement and the needs of the people, it will make the relief effort more efficient.

This paper will examine and propose emergency management plans for urban waterfront areas, focusing on the critical first 48 hours following a disaster, and detailing the most vital actions that authorities and citizens must take during that phase, given that it is the most panic-filled yet decisive stage.

I. Disaster Preparedness

The very first step of emergency management is disaster preparedness. If there is enough preparation before a disaster occurs, it is no exaggeration to say that the most important and critical emergency management tasks are already half completed. In other words, *at the moment of the disaster*, it is too late to discuss and determine what the authorities, first responders, and residents should do.

This stage of preparations for potential and looming crises facing our community might be divided into three sub-stages. The first is to identify the risk factors in the community. The second is to assess the mitigating factors in that community. The third is to plan, check, and take actions for effective emergency response. These sub-stages are contained within the larger stage of general disaster preparedness. Each sub-stage will be chronologically depicted in this section.

i. Identifying Risk Factors in Communities

It is easy to imagine that firefighters do routine checkups on households regarding simple yet relevant issues, such as the presence of vulnerable members (*i.e.* seniors and children), fire hazards, and safety precautions. It seems to be a given, but the first step of disaster management is an extension of this because if we look out at the broader area, not only around the house, we can see locations where there are hazardous materials, such as gas drums, places where children gather, such as schools and parks, places where there are crowds, such as hospitals, and areas where there is heavy traffic, as risk factors.

One of the cores of disaster management is measures for minimizing the death toll. In this first stage of emergency planning, information gathering and analysis have great significance. If the useful and correct information for verification of danger can be collected prior to any potential disasters, and that danger can be eliminated through adequate information analysis as a result, the potential impact of disaster will for certain be diminished. From this standpoint, it is sensible to extract dangerous factors from structures such as energy plants, chemical storage facilities, fuel transport vessels and vehicles to protect and strengthen surrounding infrastructure and routes that are vulnerable.

1) Identifying Risk Factors in Cities

It is imperative to recognize the ultimate goals in creating emergency plans. These goals are to identify vulnerabilities in order to reduce or, if possible, eliminate them, and to prepare to mitigate the consequences of disasters[5]. In order to achieve these goals, it is necessary to consider the elements that are composed of the possibility of threats, the criticality of infrastructure, and the vulnerability of people.[6] In terms of these elements, there are large numbers of check points in cities. Accordingly, for effective disaster preparedness and response, it is important to embody these elements into three concrete indicators based on their characteristics as risk factors.

The first category of risk factors is natural conditions. They are determined by the degree of the slope of the land, the firmness of the ground, and the proximity to the shoreline. Fire runs fastest up slopes, soil liquefaction can occasionally occur in reclaimed land, and earthquakes can bring tsunamis. The second category is structural conditions.They cover some of the characteristics of the city; narrow streets, dead ends, high density of houses and population, and closeness to hazardous materials, such as gas stations, small factories and vehicles. In particular, waterfront areas are the most highly and densely developed as hubs of logistics and transportation. The third is human-related conditions. They can be analyzed as the age of the population, the number of patients in hospitals and small children in schools.

In a crisis, even residents knowledgeable of the local geography can become confused by debris and fire obstructions on their way to assembly points, such as school grounds, parks, vacant land and parking lots. As a result, it is often more beneficial for local residents to make mental notes of the local landscape in their daily lives; walking and memorizing through mapping local landmarks, verifying their knowledge of their own hometown.That is to say that it is worthwhile walking through the main roads and backstreets with residents who are familiar with that area to check on those landmarks and finally to create a map with residents and the local government.

2) Case Study - Omori -

A prime example of this attempt was realized in Omori, Ota-ward in Tokyo. On July 10th and 12th, 2012, the chairman of the neighborhood association, the head of the branch office of Ota Ward Office, and the chief of the disaster protection management section carried out an on-the-spot survey in Omori with a team from the Tokyo University of Marine Science and Technology with the aim of creating maps. This area is designated by Tokyo Metropolitan Government as one of the areas most vulnerable to the potential collapse of old wooden houses, the spread of fire, and the blockage of evacuation routes by debris from collapsed buildings and walls in the event of an earthquake.[7] Since this town was historically constructed as a harbor area for seaweed (*Nori* in Japanese) fishermen's boats, old wooden houses are situated on both sides of winding narrow paths, which used to be mooring points for *Nori* fishermen's boats from the sea shore to their homes. This town is 500 meters from shore line of Keihin Canal that connect with Tokyo Bay, and surrounded by Uchi River in north and Nomi River in south, which are flow into Keihin Canal.The town is from one to two meters above sea level. This historical town is designated as one of five waterfront cities in Ota-ward by the Ward Office.[8]

To minimize these risks, *i.e.* flood, tsunami, collapse, fire, and blockages caused by debris, authorities recommend residents use flame-resistant materials for new roofs, walls, floorings and fences to prevent the accumulation of embers. Another significant policy is to widen roads, mainly by means of so-called "setback", by which a householder must rebuild his/her house to the rear of its original position in order to widen the road. However, these methods are too heavy a burden for residents, especially for senior citizens, in terms not only of expense but also inconvenience.[9]

Therefore, residents utilize grassroots networks that have been in existence for a many years in the neighborhood as the most effective way of transforming and improving risky neighborhoods into ones able to withstand disaster and to cope with long-term potential problems - in the case of Omori, death caused by collapsed buildings and fire. Having struggled with these issues, the residents in Omori have organized very well-trained volunteer

groups of fire fighters. Also, they have developed close ties with the local authorities, fire stations, and neighborhood associations. Since these efforts clearly mitigate risk factors, it is appropriate to verify these mitigating factors in the next chapter. In this section, natural and structural risk factors in a specific neighborhood in Omori will be examined below. The following map, Figure 1, illustrates the location of Omori as an urban waterfront nearby Tokyo International Airport (a. k. a. "Haneda Airport").

Fig. 1 Map of Omori, Ota-ward, Tokyo, Japan
(Source: Existing Land Use, Ota-ward, 2006, http://www.city.ota.tokyo.jp/kuseijoho/ota_plan/kobetsu_plan/sumai_machinami/kukorinkaibugrandvision2030.files/1sho.pdf)

3) Mapping Risk Factors in Omori

The most famous -- and infamous -- characteristics of Omori are its narrow, winding streets and dead ends. Fire engines need streets that are at least four meters wide in order to gain access. The following map is highlighted to represent the width of the roads in Omori. Simultaneously, as residents also need open access to roads as fire escapes, the map also emphasizes the corners of dead ends using diagonal lines. These are structural conditions that should be assessed as risk factors. In addition to these conditions, this urban waterfront area is only a few feet above sea level and half a mile away from shoreline.

The following map, Figure 2, shows visually the risk factors in the community to help reduce the exact risks that can magnify the impact of a disaster.

ii. Assessing Mitigating Factors in Communities

In contrast to the risk factors, there are some natural or structural conditions that mitigate the effects of an incident. For instance, the contour of an area can be helpful in an evacuation because, in cases of tsunami, flood, and liquefaction, a higher altitude will allow an escape route or a shelter to avoid the inundated

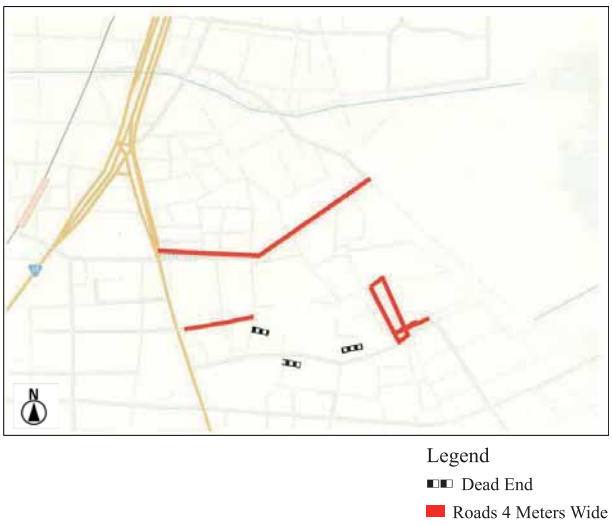

Fig. 2 Road Map in Omori
(Source: ArcGIS Published Map by ESRI)

zones. Some factors are intrinsically fire-proofing, such as wind directions, humidity, open space, which all prevent the spread of a fire; even particular species of trees can deter a fire. In addition to that, the proximity to the site of the fire of fire departments, hospitals, and main roads, which enable first responders to reach the site more quickly, can affect the response time. These elements all mitigate potential damages from an event.

In this second stage of emergency planning, mitigating factors should be precisely calculated so as to not overlook or understate the risks. Therefore, mitigating factors should be numerically explained. One important question that should be examined is how long it takes for fire engines to arrive at a particular scene from the nearest fire station. For instance, this can be displayed from 0 to 4: If fire engines arrive in three minutes, the value is 0, with each subsequent interval representing three additional minutes. In addition to this factor, distance and capacity of nearby hospitals, presence of main roads, density of trees, location of open space, and recorded frequency of fire breaking of a site are also considered.

1) Assessing Mitigating Factors in Cities

Particular factors may mitigate catastrophic situations caused by natural or man-made disasters, as we have examined above. For instance, flood gates, outer tide embankments, interior embankments and drainage pumps are expected to function in the case of high tides.

Still, these mitigating factors' effects may not decrease the severity of the crisis. For instance, the main roads that are supposed to be emergency transportation networks for emergency vehicles will be filled with the general public and their vehicles, who are trying to evacuate from the epicenter immediately after

the disaster has struck, to go home, to pick his/her family members up, or to even get essential items, such as water, food, gasoline, etc. Open spaces that are designated as sheltering places may be flooded and unable to accommodate the required number of evacuees. Particularly gymnasiums, parks, schools, the first and second floors of buildings, and other low-lying areas may not be accessible in cases of high tides or tsunami. In addition to that, if large buildings that were designated as shelters are likely to be damaged by the disaster, they may be unusable until a structural assessment has been carried out and they have been deemed safe for use. Therefore, it is imperative to calculate accurately mitigating factors for effective emergency planning.

2) Mapping Mitigating Factors in Omori

In terms of geological conditions which are fixed, nearness to the shore line is generally evaluated as high risk from viewpoint of the possibility of tsunami and flood. However, Tokyo Bay extends far inland from the Pacific Ocean, and therefore, tsunami are not predicted to reach the Tokyo Port area. Additionally, the height of tide embankments are 4.7 meters, sufficient to cope with the maximum height of a tsunami predicted by Ota-ward local government of one meter in Omori.

On the other hand, structural conditions, unlike geological conditions can be handled. Fire engines cannot access narrow streets perfectly, but fire hydrants and extended fire hoses might mitigate this problem. The map displays the location of fire hydrants, fire extinguishers, and the water for extinguishing fires and the distances from the four-meter-width roads are explained numerically. The open spaces also mitigate the risk as temporary assembly places. Since, on the occasion of an earthquake, utility poles may be toppled, power lines may hang down on the streets, and signboards and windows of buildings may fall and shatter, it is important to congregate in open spaces as assembly points in order to assess the situation, especially in densely crowded cities, even if those spaces are limited in size. The open spaces are bordered by green lines. Fortunately, there are a number of open spaces in Omori.

The map below, Figure 3, shows how it is mitigated by particular factors; where people congregate in the event of a disaster; which roads has four-meter width to be used as fire engines and rescue squad approach.

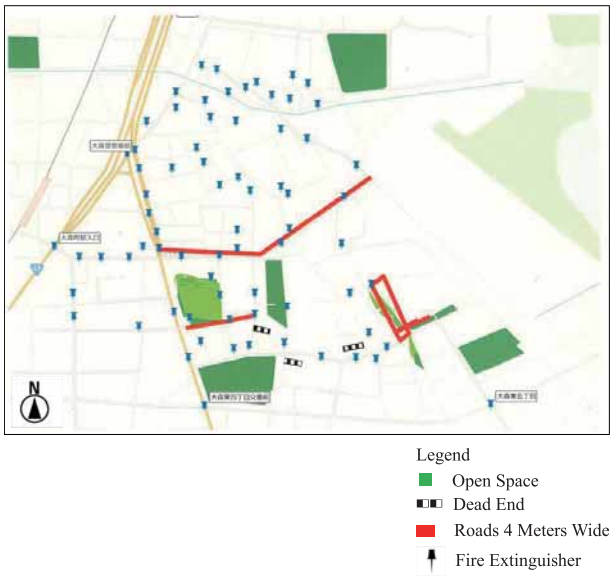

Fig. 3 Fire Extinguisher and Open Space Map.
(Source: ArcGIS Published Map by ESRI)

ii. Preparedness

After having verified the risk factors and mitigating factors of the port area, it is necessary to prepare for emergencies. Beforehand, emergency services can collect the data that will be needed at the moment of disaster and analyze how to conduct search and rescue missions using this gathered data.

When the World Trade Center was attacked on September 11, 2001, the city's Emergency Management Center was located in the World Trade Center complex. Therefore, "all the hardware, software, and geographic data that the city would normally use for its own Geographic Information Systems (GIS) response to a major disaster was destroyed."[10] Obviously, their destruction fueled the existing confusion and chaos, thus making the response slower and less effective. Fortunately, the city had relatively new data sets known as NYCMap, the city's standard cartographic basemap. Besides that, there were various governmental departments providing a detailed description of the infrastructure and data sets for the search and rescue operations. The New York City Department of Design and Construction (NYCDDC), the New York City Department of Environmental Protection (NYCDEP), the New York City Department of Transportation (NYCDOT), Empire City Subway (ECS), New York City Transit (NYCT), the Metropolitan Transportation Authority (MTA), the Port Authority of New York and New Jersey, that had held information and datasets for New York City maintained some data and maps of the city's infrastructure, which aided the emergency response.[11]

On the occasion of the Great East Japan Earthquake, the three neighboring prefectures of the epicenter, Iwate, Fukushima, and Miyagi were completely devastated, with the local governments ceasing to function as their personnel were killed and buildings destroyed. They also lost their registers on residents, so they could not reach out to any prospective survivors or verify if anyone was indeed missing. These two instances show that it is important to spread crucial information across various governmental agencies in different locations so that they can be actually utilized in case of emergency.

These experiences in a crisis provided valuable lessons for emergency services. Consequently, some vital procedures have been established in disaster management. These are worthy of detailed note below.

1) The Redundancy System

The experiences mentioned above led to the creation of what has become known as "The Redundancy System". This has become the common emergency management practice currently in use. To increase its success in coping with a crisis and to minimize failure in disaster management caused by loss of information and datasets, and the death or injury of personnel in the authorities themselves, the Redundancy System states that emergency response systems ought to contain parallel or "redundant" systems so that a fatal blow to the authorities in charge or even the annihilation of any one agency can be covered and backed-up by another. For instance, if the Manhattan system is incapacitated, the same data will be held in reserve in Albany, thus ensuring operational response.

To secure the effectiveness of this system, comprehensive data and information must be collected and stored in order to effectively meet all potential scenarios in the future. This would include designing redundancy into the system in several areas: the regional transportation network, agency personnel, communications and utilities, control centers, equipment and supplies.

In situations like these, information that is critical to search and rescue missions must be distributed to first responders promptly so that they accomplished them efficiently. Some questions worth keeping in mind are, "Where is the entrance or other access points of the building?", "Which hospitals can handle a high number of serious injuries?", "How are the injured transported to those hospitals?", and "Where will the people go? Should they evacuate to the nearest school, park, or any other public building, or should they stay at their own place?" If the authorities can predict the movement of residents and plan accordingly, they can dispatch rescue crews and dispense relief supplies more swiftly.

In the aftermath of the Great East Japan Earthquake, in Miyagi prefecture, all family registers were lost in the tsunami. Both the local government and the Legal Affairs Bureau had records, but they did not distribute these records as nationwide networks to places remote from the disaster zone. As a consequence, having data stored at separate locations was ineffective due to those locations both being destroyed simultaneously. Documents of residential domicile in this town were lost completely. Medical data in hospitals such as MRI and CT scans and medication documents were also lost.

All these emergency responses and decisions based on the critical information require protecting information in the any serious crises.

2) The Assembly Area

"The Assembly Area" is designated as a temporary place to gather in case of emergency and is distinguished from shelters or command posts. In an ideal situation, the assembly areas nominated should be protected structurally from the affected areas where there are potentially unstable buildings, and should be available and accessible at all times while being close enough to and yet far enough from any danger areas. They should also be situated close enough to alternative assembly points in order to allow people to move away from the primary assembly area to those alternatives, if necessary.

On the other hand, in the areas affected by the Great East Japan Earthquake, entire towns suffered fatal damage from the tsunami, and people were unable to assemble. Some spent the night in extreme distress and cold in the open air. Some villagers who were fortunate enough to be able to reach shelters heard that others had not been so lucky and that other shelters had been destroyed by the tsunami. Therefore, it is essential to be aware that people will not always be able to reach functioning and intact assembly areas in crises. Nevertheless, it is imperative that a number of well-prepared assembly areas are designated prior to disasters.

3) Succession Plans

"Succession Plans" establish orders of succession of both personnel and facilities to alternative ones. The purpose of succession is to secure the functions of crisis management in an emergency. Geographic dispersion of these alternatives is necessary, so that emergency response can function effectively.[12]

In terms of personnel, there is no guarantee of being able to meet with or communicate with emergency coordinators. In that situation, people rely on the officers on the ground to give clear instructions. Succession plansgive those officers the authority to make executive decisions,so long as this authority has been previously planned for as acontingency. So, even if an emergency worker loses contact with his/her superior, he/she will defer to a prior-agreed substitute decision-maker, or, in the absence of one, take on that responsibility him or herself. Succession plans should establish clear instructions and rules so that designated personnel can perform their duties.

Also, alternative operating facilities are essential. Alternative facilities and personnel must be previously designated and prepared in order to perform the essential functions of disaster management. Facilities will be selected from existing infrastructure. These facilities should be geographically "close enough, but far enough"[13] to operate in safety. To acquire such adequate facilities, not only interagency cooperation and agreement, but also public-private partnership and mutual aid agreement are required to provide alternative site capabilities. Alternative facilities should pro-

vide the capability to perform essential functions under various threat conditions, and offer sufficient space and equipment to sustain operations for up to 30 days.

In *Fukushima*, "the Off-Site Center" was located approximately five kilometers from *Fukushima Dai-ichi* Nuclear Plant. Immediately after the earthquake, it was hit by a blackout, and emergency power generators also ceased to function. After the explosion of the Nuclear Plant, radiation levels increased in the Center, since it did not have an outer air shutoff system. Agents from 20 organizations were supposed to gather in this Center, but, in fact, only 15 personnel from three organizations were able to. In reality, it did not function and the Center was transferred five days after the incident to the Fukushima prefectural office 60 kilometers away.

Also, in *Ookawa* Elementary School, located four kilometers from the coast in *Miyagi*, North-East Japan, the Principal was not at school on March 11th, 2011, the day of the disaster. After the earthquake, students stayed for 40 minutes in the school yard while the vice-principal and teachers discussed where they should evacuate to. When a decision was finally made, pupils started to walk along a river to a bridge, and were engulfed by the incoming tsunami. 74 pupils out of 104 died. Because the vice-principal was not designated decision-maker and succession planning guidelines, he was ill-equipped to make informed executive decisions. Even if the Principal had been there, there would have been no guarantee of swift and appropriate action. Nevertheless, this most tragic event in Japanese history laid this school open to criticism because of a lack of succession planning and leadership.

4) Logistics

"Logistics" plays a vital role in saving lives. However in times of crises, logistics may be hampered by choke points. Highways, national roads, and streets may be damaged or blocked. Therefore, a key element in emergency supply to the epicenter of disaster areas could be the reopening of those roads.

However, when the disaster damage is more serious, logistics is crucial, especially, in order to rescue the sick and wounded from isolated areas. In the case of Great East Japan Earthquake, this meant intensive efforts to reopen a single road to the stricken area from outside by the removal of debris and the repair of the road surface. The elimination of road obstacles (so-called "*Keikai*" in Japanese) was the very first mission of the emergency services after the disaster. This was known as "Operation *Kushinoha*" (teeth of a comb), which managed to reopen National Road Number 4, enabling access to eleven feeder roads which could then reach damaged coastal areas, rather like the teeth of a comb, emerging from the main artery. Within three days of the disaster, 15 roads were reopened on 15th March.

On the other hand, one of the most serious problems after the Great East Japan Earthquake was lack of and loss of emergency provisions. Food and Blankets were damaged or destroyed by the tsunami and survivors suffered hunger, thirst, and cold. Therefore, the main priority in a disaster is sufficient stockpiles of food, water, and blankets. In addition to that, since concentration of reserves in one location -- in the case of the Great East Japan Earthquake, at an elementary school -- did not significantly help evacuees due to damage to emergency provisions, dispersion of reserves is now regarded as preferable in order to hedge the risk. The unavailability of emergency supplies is now regarded as a fatal factor in exacerbating the situation after the Great East Japan Earthquake.

These phenomena concerning logistics might be mitigated by more thorough preparedness, such as earthquake-resistant piers and roads; cooperation agreements between the local governments and the construction companies to respond more swiftly to emergency situations; and larger reserves of emergency essentials more broadly dispersed.

5) Traffic Control

The most important task in disaster management by the police department is traffic control. Immediately after disasters, people try to get home, either by vehicle or on foot. The main roads are filled with people and vehicles — the so-called "stranded commuters."

Tokyo Metropolitan Police Department has released a map detailing potential traffic controls in the case of emergency on its website[14]. According to these regulations, the area within Ring Road Number 7 will be designated a no-entry zone while within Ring Road Number 8 will be a limited access area. Seven routes: National Highways; Metropolitan Express Ways; National Routes 4, 17, 29, 246; and Tokyo Metropolitan roads, will be used only for emergency vehicles and entry will be prohibited for general traffic. Moreover, if more serious damage were to occur in the center of Tokyo, the Department may regulate still more.

New York City is also located in a port area and is composed of islands. The greatest concern of the New York City Police Department is how they might process evacuations from these islands to the safer mainland. The lesson learned from the September 11th terrorist attacks -- in which a supposedly disaster-proof building collapsed — is "Never Say Never."[15] Therefore, preparedness for saving lives in New York City is comprehensive. Questions and answers are clear: If the Brooklyn Bridge is structurally damaged and cannot be used to evacuate; if the tunnels are flooded; if a four-lane road is the only route to the stricken area; there are no scenarios left to chance and up to 50 landing craft are available for evacuation. Simultaneously, the authorities will secure one lane of a road to the disaster area in order to dispatch emergency services and equipment to the stricken zone while three lanes will

be open to the public for evacuation from the epicenter.

6) Templates for Preparedness

At the conclusion of emergency preparedness, in order to contain the disaster, in the best possible manner, we would like to propose a set of templates for each and every first response organization, be it law enforcement or any other organization that will take part in this gigantic effort. In order to simplify the retention of the suggested steps, the presentation is in the form of bullet points that exemplify the steps that need to be taken by the first response personnel as following templates Fig. 4-1 to 4-4. These templates are predicated upon the assumption that each organization that has to be part of the emergency response will have to create a set of emergency plans that should be customized based on the more specific nature and availability of resources of the given organization.

As noted above, in any emergency plan there are always inherent problems to which suggested solutions are presented which, again, should be customized based on the role of the given agency. However that may be, it is worthwhile to examine the emergency plans by checking item by item in these templates.

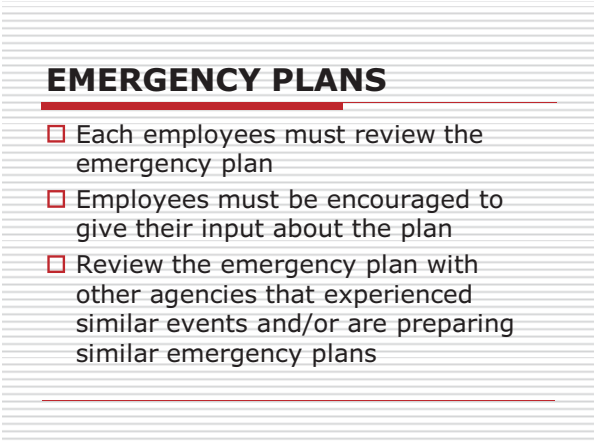

Fig. 4-1 Template for Preparedness

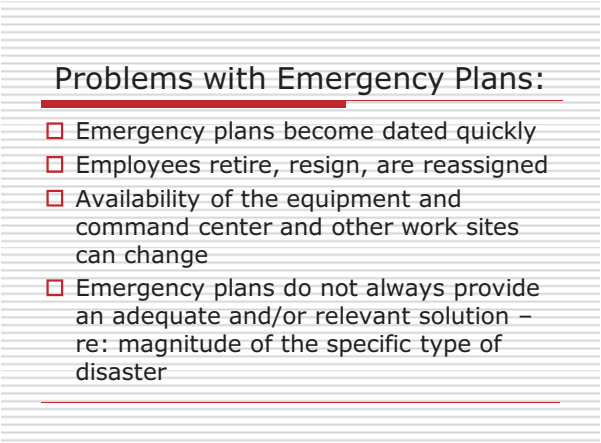

Fig. 4-2 Template for Preparedness

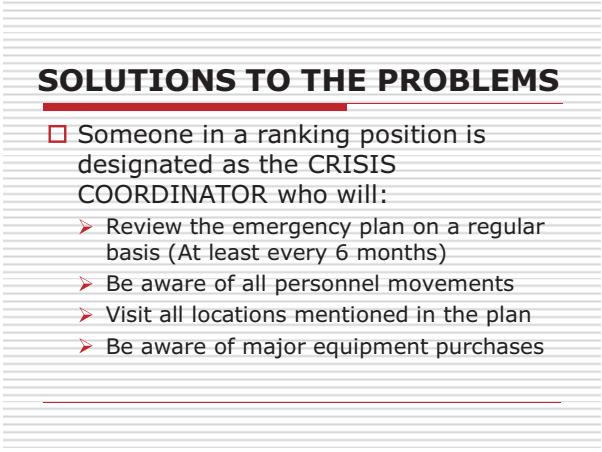

Fig. 4-3 Template for Preparedness

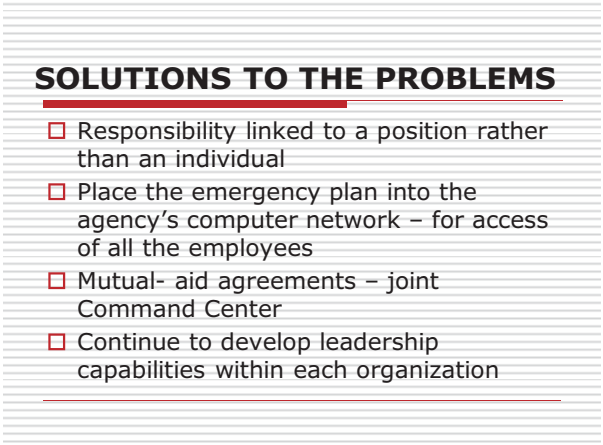

Fig. 4-4 Template for Preparedness

II. Emergency Response

In this stage of emergency planning, what kind of data helps first responders? The answer is totally different from the three stages of preparedness depicted above, i.e. identifying risk factors, identifying mitigating factors, and preparation. For those three stages, the data and information was examined in minute detail and a number of detailed maps were created by emergency services to aid prompt response.

In contrast, for emergency response, the commands should be clear and simple because in the chaos and confusion of a disaster, dispatched emergency crews may not necessarily be familiar with the zone to which they have been deployed. Therefore, templates for emergency response must be clear and manuals simple. Complicated maps and commands will not help first responders and may even cause confusion for them. To show the location of command posts, evacuation routes, bridges, tunnels, and building access points are sufficient. These next two sections aim to make clear what should be done in order to help emergency services.

i. Phases of Emergency Response

It is more helpful to divide this emergency response stage into 3 phases because needs will change as the situation evolves. From the exact moment to within hours of the disaster, the period should be called Phase 0, in which search and rescue mission might only be done by whatever tools, however primitive, inefficient, or inefficient they might be, that are available, or even by hand; this is the so-called "light rescue". There is no reliable supply of running water or electricity. Since survivors are starting to take refuge from the point of origin, traffic congestions will be common, which will obstruct the mobility of rescue vehicles.

The next stage, Phase 1, is covers the 24 hours after the event, which is also the most chaotic time. The number of severely injured will surge and will need to be treated at the hospitals. As the logistics network is destroyed, supplies will run short. Survivors start to hoard the remaining supplies, such as bottled water, canned food, flash lights, and so on, which will incite social unrest. All these will make the rescue and relief effort much more difficult.

Lastly, the period from 24 to 48 hours after the disaster is categorized as Phase 2. External assistance will start to reach the area. Heavy rescue, with the appropriate equipment and the experienced staff, commences, but coordination will still not be sufficient because clear will not be established yet. The scene is still confusing and disorderly.

Throughout the three phases, control of the disaster area is both critical and the most difficult thing to achieve. What are the obstacles to the coordinated management of the crisis? Chains of command exist in specific sections of police and fire departments. However, communication channels between different governmental organizations may not be smooth, which may hamper inter-organizational cooperation. In fact, the Fire Department of New York City (FDNY) was unable to communicate with the New York City Police Department (NYPD) on September 11th, 2001 due to radio frequency differences. Additionally, the fire fighters could not contact their command post from inside the World Trade Center because of limited radio availability. Now, these flaws have been rectified through the concerted efforts of a plurality of emergency services for the coordination of C4s: command, control, communication, and coordination.[16]

In addition to the fundamental elements of C4s in crises, some more concrete on-the-spot actions determine the fate of a nation and its people when struck by disaster or catastrophe. These actions are, for example, the *modus operandi* of evacuation, restoration, and logistics.

ii. Evacuation, Restoration, and Logistics

1) Evacuation

It is not possible to evacuate everyone immediately after a disaster. Accordingly, four methods of evacuation must be phased in.

At the outset, a limited number of those who are in the most dangerous and critically affected zones should be rescued. This is the first method of evacuation: "partial evacuation." The second method is "building evacuation." Even if high rise buildings are earthquake- and flood-resistant, residents on lower floors may need to be rescued. Thirdly: "full evacuation." When the damage extends far and wide, authorities choose this type of evacuation. The Japanese government designated Iitate village in *Fukushima*, which is located within 20 kilometers of the *Fukushima Dai-ichi* Nuclear Plant, for full evacuation, to be achieved within a month. The fourth method is "sheltering." As mentioned in the previous section, sheltering spaces cannot be relied upondue to possible limitations in available space. It is a particularly difficult task to nominate places of shelter. For instance, a gymnasium in Miyagi prefecture was situated around one kilometer from the shoreline and eight meters above sea level, and was therefore designated as a safe shelter. Yet, one hour after the earthquake, a three-meter-high tsunami engulfed it killing 13 people.

In addition to these logistical problems, there are human factors to consider. In times of crisis, people do not necessarily obey the orders of authorities. For emergency workers, it may be difficult to persuade residents to leave their family homes and evacuate at short notice. Pet owners, for example, may be reluctant to abandon missing dogs or cats. The elderly may be disorientated and unwilling to leave familiar surroundings even in times of crisis. So,housing and food may also be needed to accommodate pets within shelters. Also, practical information by the emergency services given to residents to inform them of procedures in times of disaster is helpful from the view point of constantly keeping residents alert to the dangers of not complying with emergency orders to evacuate.[17]

2) Restoration of Infrastructure

The restoration of infrastructure is a pressing need in crisis: roads, railways, highways, high-rise buildings, residences, *etc*. Unstable buildings may easily kill people by collapsing. Surveys and emergency restorations can only be done by general construction companies who have the capacity to dispatch specialists and equipment.

Immediately after the March 11th earthquake occurred, a general construction company started taking measures to control the situation. At 23:30 on 11th March, on the very day of the Great East Japan Earthquake, the first truck carrying construction materials and relief supplies departed from its Niigata office to the epicenter in Miyagi. Following that, more than 400 trucks rushed back and forth carrying the machinery and materials needed in the stricken zone from the Headquarters in Tokyo and the Niigata

office. This included 16,000 meals, 170 temporary lavatories and daily necessities.

Simultaneously, for general construction companies, it is imperative in a crisis to secure the infrastructure. On 12th March, 10 civil engineers, led and commanded by their senior managing officer, were dispatched to the stricken zone to survey structures. They used National Road Number 4, an artery reopened by *Keikai*, to reach Niigata, and then finally arrived at the damaged coastal area, Sendai, in the morning of the 13th March through feeder roads ("*Kushinoha*", teeth of a comb), which emerged from National Road Number 4. Their first missions were to identify no-entry areas, conduct surveys and take temporary measures to support and strengthen damaged buildings in order to reduce the risk of death and injury through collapse.[18] Until the end of March, a total of 300 technical experts were deployed by this contractor.

3) Logistics

Reconstruction of transportation networks are also at the heart of logistics. Traffic had been cut off at many places along the highway, and a lack of gasoline, vehicles, and personnel were extremely serious problems.

In addition to this bottleneck in the transport system, the productive capacity of essentials, sorting items according to destinations, and the arrangement of goods in such a way as to easily send them to victims in shelters, also posed major logistical problems. In crisis management, the physical distribution system must be totally coordinated from the source of supply to the ultimate goals, *i.e*. the victims as end-users.

The earthquake and tsunami caused extensive damage over a wide area in Japan. Power failures brought about shutdowns or cutbacks in the operations of factories throughout the country. Even emergency transportation vehicles were caught in long tailbacks to obtain gasoline in the immediate aftermath of the event. Huge amounts of relief supplies from all over Japan were stockpiled in warehouses awaiting delivery because of a shortage of personnel to sort and deliver the supplies to victims. As result of this delay, a private logistics company offered inventory management and delivery in order to relieve the confusion.

Emergency planning should be regionally focused. Simultaneously, every jurisdiction should plan for MCIs and disasters. All plans must be simple and based on normal daily operations of the various components involved in the disaster plan. It should be exercised frequently, even if only by table top exercises. Emergency plans for mutual assistance among government, private sector, and community response also must be considered and reviewed.We can contain the impact of the disaster.

III. Recovery

Full recovery generally takes a long time, often months, or even years. On the other hand, it is vital to begin that process of recovery as early as possible. This chapter examines some plans for recovery in the first 48 hours after a disaster.

In this last stage of emergency planning, logistics is the cornerstone for relieving the situation. Two aspects of logistics function in offering encouragement to evacuees. One is that relief supplies themselves undoubtedly save lives. Another is business continuity plans that enable people to return to their daily lives: this means not only distributing relief items but also by stocking shops and super markets with the essentials people need.

Nonetheless, it generally takes at least 48 hours for that logistical process to start working and for supplies to be distributed. After this, on the third day, supply chains should be fixed and shelters managed by residents, authorities, and volunteer groups, and people should have gradually recover their equilibrium. On the other hand, evacuees may start complaining about the measures devised to deal with the situation, especially those measures relating to the distribution of relief supplies, food, and shelter.

Consequently, it depends on sufficient preparedness as to how fast people can recover from catastrophe and return to ordinary life. After the Great East Japan Earthquake, the authorities recommended that people stockpile necessary items for three days to one week in their homes in order for them to stay at home in the event of a disaster, thus lightening pressure on limited shelter space. This policy is being adopted, especially by residents of high-rise buildings who cannot easily go up and down without elevators. When people do not have to wait for external assistance, a great degree of confusion and anxiety may be prevented.

Conclusion

On the night of March 29th, 2012, New York City and the eastern seaboard of the United States were inundated by flood water caused by Hurricane Sandy, claiming at least 90 lives in eight states. New York City had experienced a similar crisis in 2011 when Tropical Storm Irene hit the city, and was assumed to be well-prepared for a similar eventuality. At that time, the subway system had been shut down beforehand with priority given to the safety of staff and passengers. Also, a warning about Irene was repeatedly broadcasted from the Office of Mayor Michael R. Bloomberg, strongly recommending New Yorkers to stock upon canned food, bottled water, batteries, and flash lights, and to avoid using elevators, to stay inside, and to keep away from windows.

However,in the case of Sandy, the unexpected severity of the storm created more critical problems, and authorities have had to reevaluate the safety mechanisms in place to protect a metropolis

only a few feet above sea level. They are now preoccupied with constructing the most effective protection against flooding. Some scientists assert that storm surge barriers and huge sea gates are the most effective defense against future inundation. But some experts contend that critical infrastructures such as the subway system and the electricity grid, administered by the Metropolitan Transportation Authority (MTA) and Consolidated Edison Company (ConEdison), should be made more resilient to disaster.[19]

This argument corresponds to that made in Japan after March 11th, 2011, the Great East Japan Earthquake, which also experienced the collapse of embankments (so-called "*super*-embankments") along areas of coastline affected by the tsunami, which accompanied the earthquake. As we examined above, there are many dots that need to be joined to develop an emergency plan for urban waterfront areas, *i. e*. risk factors, mitigating factors, preparedness, response, and recovery. If the emergency plans for urban waterfront areas are too narrowly focused on specific situations, such as water-related damages caused by floods, tsunami, and surge, this might aggravate the impact of disaster. For example, in Queens, firefighters prepared for and predicted a flood but what they got was a fire. The most serious damage in Queens, where 111 houses were gutted as a result of fires,was caused by sparks from power lines not from the predicted dangers of flood water.[20]

It is, therefore,essential to envisage in minute detail all possible scenarios, risk factors and mitigating factors in order to devise clear and simple plans that can be performed at the critical scene within 48 hours of the disaster, which is the most panic-filled yet decisive stage for containing the impact of the catastrophe.

Finally, we would be remiss if we had not mentioned that having an emergency plan or plans is going to be sufficient without a thorough exercise plan. People can only retain that much knowledge without a periodical repetition and reminders.For this reason we suggest the incorporation of, both, table-top and full field training exercises, that can be costly but when people's lives are at stake no price is too high to pay.

Acknowledgment

I would like to express my deepest appreciation to Professor John P. ("Jack") Walsh, Captain (Ret.), NYPD, Professor Joseph ("Joe") Giacalone, Sergeant, NYPD, both of whom I highly respect and without their help my study would not have been possible. Their generosity and guidance are boundless. For that, I am forever grateful.

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都市沿岸域における緊急事態対応計画
― 発災後 48 時間の危機管理 ―

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要旨： 本研究は、2001 年の米国同時多発テロ及び 2011 年の東日本大震災を素材とするケース・スタディーを通じて、沿岸域に位置する市街地のリスク・ファクター及び減災ファクターを把握・分析し、災害抵抗力あるコミュニティづくりの方法を検討する。本研究では、自治体及び地域住民による準備が、危機管理及び災害に強い都市づくりにおいて有効な方法であることを、発災後４８時間に行政及び市民が取るべき対応に着目して検討する。
（本研究は、社団法人日本港湾協会の港湾関係助成研究として実施された。）

キーワード： 緊急事態対応計画、都市沿岸域、地理情報システム、災害抵抗力あるコミュニティづくり