

# A REVIEW OF RECOVERY PROCESS OF CHI-CHI EARTHQUAKE SINCE 1999

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**Abstract:** The Chi-Chi earthquake, occurred in 21, September, 1999 with magnitude 7.3 and epicenter on Central Taiwan, has already passed about 10 years. This earthquake had caused over 103,000 buildings collapsed or partial collapsed, more than 2,505 people death or missing. In addition, many public facilities, including schools, universities, city government halls, bridges, roads, were damaged. The lifelines, such as electric power system, gas pipe-line, or tap-water system, were also destroyed. Furthermore, local industries and economic activities on the disaster areas being closely linked with people life were seriously ruined. The huge earthquake losses with costing more than 11 billions have gradually recovered during passing 10 years. Looking back for the recovery processes, it is worthy to figure out the reconstruction process in detail and find out the facilitating or impairing factors of earthquake recovery. According to this research analysis and the recovery experiences of 7 years after the earthquake, the physical recovery, such as public constructions, would be more easily done than unphysical recovery, such as livelihood, industry or mental health recovery. Besides, comparing to the given process and flow path for recovery, regulated by the government, the actual implementations of recovery processes are quite different. Both the direct influencing factors induced by earthquake disasters and external influencing factors caused by non-earthquake disasters may have unexpected impacts to earthquake recovery. The results of this research will be referred to recovery for future large-scale earthquakes.

## 1. INTRODUCTION

The Chi-Chi Earthquake, occurred at 1:47 local time, in 21, September, 1999 with magnitude 7.3 and epicenter on Central Taiwan, because of fault dislocation, was the largest scale earthquake from 1935 until now. The Chi-Chi Earthquake has drawn a lot of attention. Not only has this earthquake caused thousands of people deaths or missing and huge property losses on the disaster areas, but also it was the first large-scale earthquake after Taiwan modernization. Therefore, the large-scale disaster management processes, including emergency response, relieving the victims, recovery or reconstruction, were dealt on very limited recognition or preparedness. In other words, the recovery process of the Chi-Chi Earthquake is progressed on condition of error tries. On this year, 2009, to be the tenth year of the Chi-Chi Earthquake, looking back for the recovery 10 years, it is worthy to review and reorganize the recovery process or reconstruction experiences so that the research results could be useful to manage large-scale earthquake disaster for the future, or even could facilitate recovery process smoothly or mitigate earthquake disaster.

Based on above-mentioned the research motives, the articles and documents related to the Chi-Chi earthquake will be gathered, reviewed and analyzed. First, the recovery processes about 7 years<sup>1</sup> after the earthquake will

be reorganized so as to figure out the priority for dealing with various affairs of earthquake recovery by time series. Secondly, the influencing factors of the achieved percentage of recovery scheduled progress for various recovery affairs will be analyzed. Finally, by analyzing the influencing factors, the primary suggestions and reviews will be proposed for disaster mitigation and earthquake recovery so that the research results could be referred for researchers for their studying related to the large-scale earthquake.

The main contents of this paper are included: 1) The disaster general description for the Chi-Chi Earthquake; 2) The initial stage for recovery process; 3) The process for recovery; 4) Analysis of the main influencing factors for recovery process; 5) The primary conclusion and suggestions.

## 2. THE DISASTER GENERAL DESCRIPTION FOR THE CHI-CHI EARTHQUAKE

### 2.1 Disaster Descriptions of the Chi-Chi earthquake

The dislocation of the “*Chelunpu Fault*” with north to south direction and the epicenter on the central Taiwan caused the Chi-Chi earthquake. The devastation of the Chi-Chi earthquake is huge, including 2,455 deaths and 50 missing. In addition, 755 people had hurt seriously and over ten thousand people had light injuries. The property damages were also significant. There were 38,935 units of

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<sup>1</sup> “921 Earthquake (Chi-Chi earthquake) Post-disaster Recovery Commission, the Executive Yuan” was established after the Chi-Chi earthquake and was closed on February, 4, 2005. It took about 6 years and 4 months. All unfinished recovery works were returned to related central

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government to implement continuously. Therefore, 7 years was used to be a time period for analysis.

houses collapsed and 45,320 units of houses partial collapsed<sup>2</sup>. Besides, many public infrastructures, such as school buildings, government offices, bridges, roads, lifelines, and large-scale farming or manufacturing equipments, are damages seriously by the earthquake. According to the government statistics, the direct losses are as huge as 115 hundred million US dollars.

## 2.2 Characters of damage

There were several characters for this disaster and victims areas as the followings:

1. *Victim areas were across several administrative districts:* With magnitude 7.3 of the Chi-Chi earthquake, but the focus of the earthquake was only 8 km depths. Besides, the length of the thrust dislocation of the *Chelunpu* Fault of the earthquake were across 96 Km<sup>3</sup> from north to south. Therefore, the fault which expressed significant energy caused strong shakes and devastation. The length of the disaster areas from the north to the south was about 105 Km and from east to west was about 80 Km. The disaster areas includes 31 cities, towns or counties totally, if Taipei city, Taipei county, Chia-Yi city and Chia-Yi county far away from the disaster areas were also counted, which had damaged by this earthquake with deaths and buildings collapsed.
2. *Serious landscape changes and geological destructions:* Because of fault dislocation significance (e.g. the northern end of the fault changed its location vertically about 11 M) and the eastern side of the upper part of the fault was mountain and village areas so that the geological structures were fragile. Therefore, the movements of the fault thrust significantly had caused many damages, such as about 180 collapses or landslides, about 130 places for stones or earth piles. In particular, the broken area of earth's surface of *Jiou-Fen-Er-Shan* was about 200 hectares. The landslide area of *Tsau-Ling* had produced earthworks with the volumes about one hundred million and twenty million M<sup>3</sup>.
3. *Public facilities and infrastructures are damaged seriously:* Most parts of the disaster impacted areas were on the farming areas or villages with less urbanization and lower density of population. The public facilities and infrastructures located on the farming area or village were aged styles. Besides, most of roads and bridges were located across mountain areas with steep landform or across over the north-to-south fault. Therefore, there were many school buildings, accounted totally 1,546, which were damaged at different levels. The 293 school buildings must be removed for reconstruction. The 250 public facilities, such as administrative buildings, public activity centers, fire fighting and police offices, are whole collapsed. At least 600 public facilities were partial damaged dangerously.

<sup>2</sup> The data is gathered from The Architecture and Building Research Institute, the Ministry of Interior. If it is counted by the unit of household, the totally collapsed households were 50,652 and partial collapsed household were 53,615.

<sup>3</sup> The main thrust fault is 85 Km from north to south, extending 11 Km from east to north, totally 96 Km (data resource: Central weather Bureau).

4. *Earthquake timing reduced the death or injury numbers:* As the above-mentioned, thousands of school buildings and public facilities were damaged seriously or totally collapsed. However, the earthquake timing on daybreak may reduce the death or injury numbers in the public facilities, because there was almost no one inside the buildings.

5. *Both the lower-floor old style of houses and the higher assembled style of buildings were destroyed together simultaneously:* Because of most of the disaster areas on farming or village, many lower-floor old styles of houses (e.g. house made of soil and earth bricks) were on this kind of areas. Meanwhile, many higher assembled styles of buildings are constructed on the disaster area with high density of population, such as on the township areas. Therefore, both the lower-floor styles of houses and the higher assemble styles of building were destroyed together simultaneously on the same disaster areas during this earthquake so as to increase the difficulty and complication for recovery.

6. *The agriculture and tourism with the most negative impacts on the farming or village areas of disaster:* As the above-mentioned, most of the disaster areas were on farming or village areas so that the local agriculture were damaged seriously. Besides, before this terrible earthquake, the disaster areas had existed many beautiful see-sights and natural landscapes. Multi-culture characters, such as aboriginal, Fukien, Ha-KKa, Taiwanese or Mainlander cultures, also give a good opportunity for developing tourism industry.

7. *Given land system impeded the recovery process:* Most of the disaster areas were on remote mountain areas. According to Taiwanese given land system, most of the remote areas belong to government or reserved for aboriginal. Therefore, the disaster victims without land ownership, even though they had lived or farmed there for several generations, could not have the land owner right. Therefore, the given land system increased the difficulties and complications for recovery.

## 3. THE INITIAL STAGE FOR RECOVERY PROCESS

### 3.1 Launching for earthquake recovery

After the Chi-Chi earthquake, Taiwanese government took part in the disaster rescue, response and recovery affairs. For instance, in 40 minutes, "the Central Response Center for Large-scale Earthquake" is established. The Center announced 9 emergency orders and 15 important measures for disaster rescue were decided. In addition, before the daybreak, the deputy-minister of the Interior Department had arrived at the disaster area (e.g. Nan-tou county) for establishing "the Progressing Command Center of Central Disaster Reduction". At the stage of emergency response, in about one month, not only stepping into many affairs, including rescue, handling corpses, transporting necessary materials, staying victims or repairing electric systems, but also the center launched to prepare the recovery processes.

The recovery processes were complex and long-term

works, and the major processes at the government side as the followings:

1. *Establishing the necessary organizations or task-forces;*
2. *Announcing the necessary regulation;:*
3. *Getting financial resources;*
4. *Others:* there were several measures for livelihood, mental health and settlement of victims.

It is worthy to mention that “921(the Chi-Chi earthquake) Post-disaster Guiding Principles for the Disaster Recovery Affairs”, announced on November, 9, by the Executive Yuan and illustrated with the **Figure 1**. The principles were the key for supporting influentially to recovery affairs.

Comparing to the government side, on the non-government side, in about one month, the NGOs participated in preparing the recovery affair for a long-term supporting, except for devoting to emergency rescues, including:

1. *Establishing the necessary organizations and taking into recovery planning:* There were several examples worthy to mention. For instances, “921(the Chi-Chi earthquake) relief and recovery Commission of Christianity” was organized by Presbyterian Church in Taiwan. “921 Earthquake (the Chi-Chi earthquake) Assistant Recovery Division of Buddhism” was organized by Luminary Buddhist Group. Also, “Association of National Civil Post-disaster Recovery, Coordination and Supervision” was established by multi-NOGs. “921 Large-scale Earthquake (the Chi-Chi earthquake) Recovery and Relief Special Project of Tzu-Chi Foundation” was drafted by the Charity Foundation of Tzu-Chi.
2. *Supporting to building temporary staying houses:* For instance, the Tzu-Chi Foundation was signed with Nan-Tou County government for constructing simply equipped houses to settle down the victims.
3. *Responsibility for rebuilding damaged school buildings:* On, October, 19, there were 8 NGOs, volunteer organizations or enterprises, such as Tzu-Chi Foundation, Fu-bon Cultural & Educational Foundation and International Lion Clubs, announced their responsibility for rebuilding damaged school buildings with a ritual, namely “Signing Ritual for Responsibility and Donation”.
4. *Mental health recovery:* Many religious groups and volunteer organizations began to accompany with the victim and take part in their mental health recovery after the earthquake psychological trauma almost at the first time. It took time and also need a lot of human resources for this kind of social works.

#### **4. THE RECOVERY PROCESSES**

There were many factors to influence the recovery process for a large-scale earthquake of recovery, including timing, magnitude, impacted victims, recovery priority and complex etc. The whole recovery process was difficult to describe clearly, since the Chi-Chi earthquake has been to almost ten years. Therefore, in this paper, I will try to use

the content framework of “921 (the Chi-Chi earthquake) Post-disaster Guiding Principles for the Disaster Recovery Affairs” for analysis, including: 1.) Lifelines, such as electric system, water providing system etc.; 2.) Transportation systems, such as roads, bridges and railways etc.; 3.) Water conservancy engineering, such preventing flood engineering and irrigation canals etc.; 4.) Geological engineering recovery, such as landslide, mudflows recovery etc.; 5.) Public facilities, such as administrative office, civil activity etc.; 6.) Campus recovery, such as universities building, primary school buildings etc.; 7.) Culture heritages and historical architectures; 8.) Housing; 9.) Livelihood; 10.) Industry; and 11.) Community. Totally, 11 item contents for analyzing recovery processes by categorized important contents, including the implemented period of the specific recovery projects (such as Dong-Shi Bridge had been constructed and finished, Shi-Gang Dam has been repaired and Don-Shi community had been completed) and the project outcomes, illustrated with the **Figure 2** so as to identify the recovery processes as the followings:

##### **4.1 In the initial one or two months after the earthquake**

The main works were still focus on the emergency rehabilitations for safe assurance and livelihood function, including restoring water or electric systems, recovering transportation, constructing the temporary bridge, dealing with the barrier lack and dike, building temporary settlement house, rebuilding classrooms, caring livelihood and mental health.

##### **4.2 In the half a year after earthquake**

The emergency rehabilitations had almost finished at the initial stage, but the lifelines with serious damages, landslide recoveries, bridge and dike constructions were still implemented continuously. Besides, the public facilities, such as school buildings, administrative offices and assembled houses, were still halted. The victims’ livelihood was supported by the project of “Working substitutes for money relief only”. Some labor welfares, such as relax restrictions for labor insurance payments and subsidizing the labor healthy insurance were provided. The industrial revitalizations were processing to recovery agriculture facilities, local business equipments, and dairy market revitalizations. It is worthy to mention that the devoted civil foundations to help to rebuild communities, cooperating with the related government departments. The devoted civil foundations also announced their responsibility and denotation for reconstructed school buildings so as to regain students back to attend schools for studying. Besides, the government regulated several acts and regulations, including launching the “921 earthquake (the Chi-Chi earthquake) post-disaster recovery commissions” on February, 2, 2002, announcing the “Simplified Application of Building Licenses for disaster areas of 921earthquake (the Chi-Chi earthquake). In addition, several important policies are launched, including “Industrial revitalization Plan of Five Years” approved by Council for Economic Planning and Development (CEOD) on January,

20, and “Livelihood Revitalization Plan” approved by CEOD, on February, 10. These acts, regulations and plans were useful to assure the recovery policy strategies and renew the given regulations. Meanwhile, the basic land measuring tasks, such as land re-measures and cadastres renewal were processed in this stage.

#### **4.3 In one year after earthquake**

As the above-mentioned, in the half of a year, the basic physical infrastructures and unphysical recoveries were implemented continuously. At this stage, at about ten months after the earthquake, the recovery of public facilities, such as school buildings, administrative offices and civil activity centers, began constructions. In addition, the community recoveries based on the method of “resident’s participation” increased to about 60 communities, in two months and one year. However, most of the housings were rebuilt, extending to one or two years after this earthquake, which had impacted directly to victims’ life.

#### **4.4. In 7 years after the earthquake**

Except for limited rebuilding cases, most of infrastructures, such lifelines, roads, bridges, were reconstructed completely. Most of the campuses were rebuilt accomplishedly in the period of three years and half one year. In addition, most of the public facilities, culture heritages and historical architectures took more time, about 4 years, to be rebuilt or repaired. During the recovery period, many typhoons and downpours attacked the disaster area so as to cause many natural hazards, such as landslides, collapses, floods. The natural hazards had negatively impacted to recover the geological reconstruction, water conservancy reconstruction, some bridges and roads, so that the kinds of reconstructions had extended to 6 or 7 years to be done, and some of them are still not completed. Besides, livelihood, industrial and housing recovery took the longest time, because these related to complex social issues. It is worthy to mention that the major direction of industrial recovery had changed after 3 or 4 years of the earthquake. Comparing to the initial stage, the industrial recovery had changed from traditional agricultural development to a new style of industrial development. The new style of industries included eco-tourism, local culture, wine-making technique, and leisure for increasing work opportunities of local residents. Finally, considerable quantities of housing reconstructions were still delayed so that a part of victims lived still in temporary houses constructed at the initial stage. Only limited individual households had reconstructed completed, after applying construction licenses. The reconstructions of assembled buildings and larger-scale communities began at the end of the three years after the earthquake.

In sum, the recovery of the Chi-Chi earthquake in one year was focus on the reconstruction of lifelines, roads and bridges. Some acts, regulations and recovery plans were drafted and recovery mechanisms were designed at the initial stage. Then, the seriously damaged campuses began to reconstruct and most of the public facilities had been done

in 3 or 4 years. However, the flood control works, geological engineering and irrigation works, housing reconstructions, livelihood and industrial recoveries were difficulty in recovery completely, until the final stage, because of diversity and complex factors.

### **5. ALYSIS OF THE MAIN INFLUENCING FACTORS**

In this paper, I try to figure out why the recovery processes and time periods are diversity and what are the main influencing factors caused the different results, even though all of the recovery works began at the same time, according to my analysis as the followings:

#### **5.1The complications and difficulties with difference in degrees**

The recovery affairs related with many dimensions, including the physical reconstructions (e.g. pubic infrastructure constructions or geological works) or the unphysical social recoveries (e.g. livelihood and industrial recovery). Besides, both of the physical and unphysical recoveries may have mixed together so as to increase the complications of recovery. For instances, hundreds of household reconstructed and moved together into the assembled houses, which holding the same land right. Therefore, the recovery of complications and difficulties with difference in degrees would influence directly or indirectly the recovery implementations.

#### **5.2The necessary recovery regulations for large-scale earthquake were still not completed**

Whiling the large-scale earthquake, many physical and unphysical (social) conditions may change dramatically. Furthermore, the emergency response and rehabilitation were usually urgent. Therefore, it is difficult to follow the regular procedures or normal methods to deal with the recovery affairs. The laws, regulations or administrative procedures related to recovery fitted in with the ordinary time, which operated at the emergency time after a large-scale disaster, becoming rigid and inconvenient obviously. For instances, the laws or regulations related to the review institutions of urban planning and urban renew, the community renew of assembled houses with common land right of victims, the applying procedures of bank loans, or even general administrative applications would become hardly to be operated.

#### **5.3The affordable necessary human and finical resources for recovery were still lack**

All of the human and finical resources of Taiwanese government for recovery are based on related laws or regulations. However, during the disaster recovery processes in emergency time period, it is difficult to use ordinary budget quota or human resources to deal with the recovery affairs. In particular, in the disaster areas, the administrators themselves are the victims so as to reduce their recovery abilities, both in qualities and quantities. In Taiwan case, in the Chi-Chi area, it has been lasted several

generations with no attacked by the large-scale earthquake so that the given budget quota and human resources were lack for many recovery affairs.

#### **5.4 Basic information gathers and administrative methods were not accurate**

To assure the correct in basic information, such as census register data, land transcript, cadastres, etc., is important for implementing the widespread and complex recovery affairs. For instance, if a disaster reconstruction in a large land with multi-land rights of victims, with most of the buildings totally collapsed, should be implemented, then the above-mentioned basic information is needed to plan, design or rebuild for recovery. However, in the Chi-Chi earthquake case, the disaster area was located on the old style village or street, the necessary basic information is lack on records and files so as to influence the emergency recovery affairs.

#### **5.5 The radical changes caused by the large-scale earthquake were difficult to control**

Because of the large-scale of the Chi-Chi earthquake with magnitude 7.3 and the total length of the thrust fault is about one hundred meters, the large-scale earthquake caused movements, both vertically and horizontally, and dramatic changes of the earth surfaces so that many safe threaten issues, fragile and long-term factors were induced.

#### **5.6 Unexpected events**

Excepting for above-mentioned influencing factors caused by the large-scale earthquake, during the very long time recovery processes, there were still many unexpected events to influence the recovery affairs. These events included natural or artificial, physical or unphysical (social) dimensions. For instance, several strong typhoons and downpours had attacked the disaster areas. Besides, the Taiwanese Present Champion and the party-rotation on 2000 could be also treated to be an important influencing factor for recovery. For local agriculture on the disaster areas, Taiwan joined the WTO (World Trade Organizations) had key impacts of recoveries and agricultural revitalization.

### **6. CONCLUSIONS AND SUGGESTIONS**

#### **6.1 Conclusion**

In this paper, by through gathering and arranged the documents related to the Chi-Chi earthquake for passing 7 years. Then the recovery affairs and processes are categorized and compared so as to analyze the influencing factors of the scheduled progresses and time period. The results are explained as the following:

1. *Three types of recovery affairs:* As the above-mentioned, the recovery processes of the Chi-Chi earthquake included 11 the major items of contents. These 11 items of contents had different from time periods and completed priorities. Basically, the recovery contents can be induced into three types: 1). Type of physical environment or space: the recovery works related to physical environment or space,

such as lifelines, traffic transportation, water conservancy, geo-constructions; 2). Type of social recovery: The recovery works were focus on social dimensions or individual recoveries, such as livelihood, industrial and community recovery; 3) Type of mix with physical environment and social dimensions, such as the campus and public facilities recoveries. According to my analysis, the first recovery type is easy to be implemented and quick to get reconstruction result. The third type is more difficult than the first type to be launched immediately. However, if the implementing mechanism of the third type is adjusted, it could be finished in the limited time period. Even though the second type is highly related to individual victims or local communities with request for beginning at the initial stage, the second type of recovery works are impeded by influencing factors. Therefore, the second type is the most difficult in implementation and extends to a long time period, because it is easy to be influenced by external factors. In sum, the differences of the three types are formed basically the recovery processes.

2. *Analysis of the influencing factors of recovery:* The long term recovery processes were impacted always by the external influencing factors. Meanwhile, all recovery works were still in progresses. The influencing factors included basically two categories: one is about natural or physical factors; the other side is about human or social factors. The former physical factors can be separated into two subtypes: one is direct influencing factors caused by this earthquake; the other is another influencing factors caused by natural hazards, not directly caused by this earthquake. For instance, the strong earthquake caused to the landforms change, rock crack or landslide, which could be treated as the former subtype of influencing factors. Another natural hazard, such as typhoon or downpour or another earthquake, caused to more serious conditions of disaster, could be treated as the latter subtype of influencing factors. The latter type of social influencing factors can also be separated into two subtypes: one is direct influencing factors related to recovery, which is controllable or expected, form the point of disaster management view; the other is unexpected influencing factors, which is uncontrollable. For instance, drafting regulations related recovery and arranging basic information of victims could be treated as the former of social direct influencing factors includes. For instance, the Present Champion following the party rotation during the recovery processes of the Chi-Chi earthquake and Taiwan joined to the WTO, could be treated as the unexpected influencing factors. The former subtype of social direct influencing factors will have strong affections to the recovery affairs, or even impeded the related recovery works. The latter subtype of social indirect influencing factors will increase complications for recovery or delay the recovery processes.

3. *Interaction of three types of recovery affairs and two influencing factors:* As the 6.1 above-mentioned, the first type of recovery affairs is easy to be affected by the natural or physical influencing factors. On the other hand, the type of social recovery is easy to be affected by the social

influencing factors, not only to impede to launch the recovery works, but also to increase the complications and difficulties of recovery works. However, no matter the physical influencing factors or the social influencing, the more influencing factors are involved in the recovery processes, the more difficulties the recovery works are implemented. That may explain why the recovery processes have differences in scheduled progresses and time period, during the passing 7 years after the Chi-Chi earthquake.

### 6.2 Temporary Suggestions

According to the analysis of the recovery works, processes and influencing factors of the Chi-Chi earthquake, two temporary suggestions are proposed here for referring to future researches and practical implementations:

1. *Enhancing abilities of earthquake mitigation and emergency response:* According to present technologies, it is impossible to eliminate the earthquake itself in scale or to predict it accurately. However, it is possible to mitigate the disaster situations in advance by necessary methods. Therefore, how to enhance the abilities of earthquake and increasing the efficiency of emergency response are key issues to reduce greatly the recovery workloads and enhance the recovery efficiency.

2. *Reducing the influencing factors of recovery:* It is difficult to change the needs of recovery works after earthquake. However, the influencing factors of recovery, which may affect the recovery progresses, can be changed or even reduced. According to the above-mentioned analysis, it is impossible to eliminate completely the natural or physical influencing factors. However, it may have the way to reduce negative impacts. Specifically, no matter the first influencing factor caused by earthquake itself or another influencing factors caused by natural hazards will affect the recovery works. In other words, how to mitigate various secondary disasters and quick response during the recovery processes are important issues, which can reduce the recovery obstructions. Analyzing the social influencing factors, excepting for the unexpected influencing factors which can not be dealt by disaster management, most of the social influencing factors can be handled in advance. Some lessons can learn from the case of the Chi-Chi earthquake. For instance, revising recovery acts or regulations and recreating recovery mechanism in advance for enhancing the recovery abilities, cultivating human resources for recovery response and implementation, adjusting the budget procedure, assuring budget quota for recovery, operating recovery organization flexibly, or investigating basic recovery information for disaster management. All these recovery works should be implemented before earthquake disasters in advance.

In brief, the recovery works of large-scale earthquake can be implemented smoothly, only if the recovery works are ready before disaster attacks, not waiting until to be attacked by disaster. In addition, depending on various disaster experiences, each recovery works needs to be adjusted and enhanced. In other words, the preparedness of the four phases (e.g. mitigation, preparedness, response and recovery)

of disaster management is not only for response, but also to take into account the recovery need so as to arrange necessary recovery works in advance.

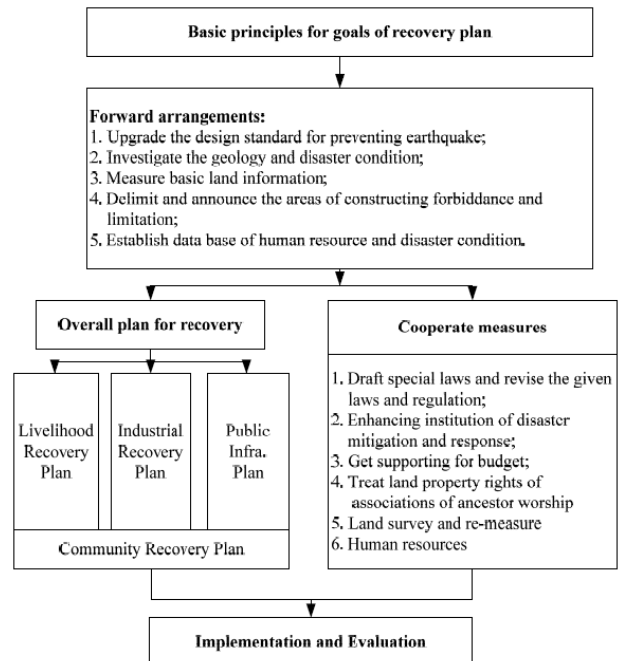
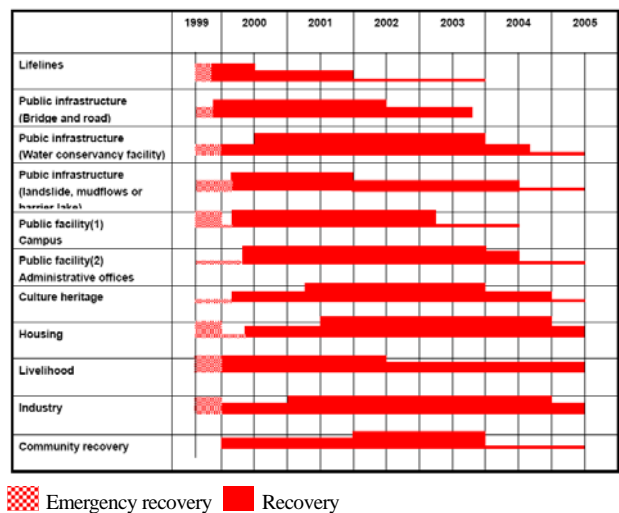


Figure 1: Chi-Chi earthquake Post-disaster Guiding Principles for the Disaster Recovery Affairs



Ps. The width of line is illustrated with the quantity of recovery works

Figure 2: Recovery processes classified by work contents of the Chi-Chi Earthquake