

## **Social Network Analysis of Disaster Response in 2014 Chiangrai Province Earthquake**

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### **Abstract**

This study aims to 1) examine the problems and contexts in disaster management policy for the earthquake preparedness following the public disaster prevention and mitigation strategy plan 2) examine the social network in local, provincial and national level which related to Chiangrai's earthquake preparedness 3) examine the guideline for the inter-organizational integration in Chiangrai's earthquake mitigation. The methodology of this study is mixed-method approach. The social network analysis is used to explore the relation among the disaster policy actors. The social network analysis is used to analyze the other relationship among the Government sector, people, and civil society in the affected area. It was found during the qualitative data analysis that the topology of the relation between the disaster management organizations is the mixed pattern of the star and the tree. Most relations were centralized to the central authority. During the emergency, the organizations at the province were united and ready to perform on duty cross jurisdiction, for Chiangrai Province's organization had planned the roles and responsibilities of each organization and organized the rehearsal previously. However, the recovery phase faced some limitations. The management process was prolonged, and there was insufficient information system and the coordination between the mitigation organizations. These limitations slow down the recovery process. The cross-functioning action such as information or resource sharing could not be fully performed. Each unit collected their own data without sharing them together. There was also the limitation in the disaster risk-evaluation and the disaster management planning. The most suitable policy to decrease the impact of the earthquake should then start by developing the inter-organizational coordination. For example, the provincial's disaster information must be shared. And the local level must be encouraged to utilize the information technology, resources allocation and thus increase the capacity to cope with the disaster. Finally, the pattern of relationship between each disaster management organizations should be flexible and adaptive to the situation.

## 1. Introduction

One of the disaster's characteristic is "the compound hazard". It means that when a hazard occurs, the first hazard might escalate cross administrative district or become the different hazard which require different dealings from the beginning. These various conditions induce "the chaos" and "the complexity" as "the emergence" in which it is not possible to forecast the scenario using linear sequence (Tavida Kamolvej, 2011). As Emile Durkheim said the whole is greater than the sum of its parts. Thus the collaboration among organizations are necessary in the disaster management. Moreover, routine performance must be able to adapt from static to flexible to cope with the varied situation during the disaster.

Therefore, the inter-government network and social network has important impact to the structure of the coordination and the information exchange in every phase of the disaster management. The social network analysis of the related organization in Chiangrai Province Earthquake will help recommending the suitable integration of Inter-organizational collaboration on the disaster management. Thus, this research attempted to answer the main question of "*What are the appropriate Inter-organizational relation structure which encourage the disaster's preparedness*", and the secondary question of "*what are the appropriates policy which encourage the earthquake mitigation follow public disaster prevention and mitigation strategy*"

### 1.1 The context of disaster operations

An earthquake magnitudes of 6.3 Richter in Chiangrai province was recorded at 6.08 pm, on 5 may 2014. It was the strongest earthquake ever reported in the area. The duration of shaking was 40 seconds. Afterwards, the moderate aftershocks (less than 6 Richter) occurred continually for 500 days (Passakorn Pathanon, 2015). Fortunately, the economic loss was less in comparative to other earthquake of similar magnitude in the other case, due to fact that the epicenter of the earthquake was in the area with low population density, in which the most land utilization is agricultural.

However, the area within 30 kilometers radius from epicenter was widely damaged. This seismic affected 7 districts, including 50 sub-districts and 609 villages. There were 107 injuries, 1 death, and 5,139 damage houses. Many roads and bridges were in unusable condition. The public building such as temple, school and hospital were damaged. Chayanon Hunsapinyo (2014) mentioned that most organizations of the disaster relief, medical service and rescue response quite efficiently during the emergency phase. But the next phase of recovery was delayed due to the limitation of the information system, manpower, budget, coordination, sharing database system, the knowledge transfer in building's risk and safety assessment.

Thus, these limitation should be considering with Department of Disaster Prevention and Mitigation Strategy Plan B.E. 2555-2559 (2012-2016) formulated the framework to empower the inter-organization collaboration supporting the disaster management in 5 issues as followings ; 1) Raise the awareness in disaster prevention into the inter-organization mechanism 2) Promote the local network resource allocation in disaster management 3) Support the Knowledge management to the local network in disaster prevention 4) Raise the awareness and formulate the disaster prevention plan and project which operated by shared budget 5) Formulate the guideline to develop the strategy of inter-organization network for capacity building in local disaster management

## 2. Methodology

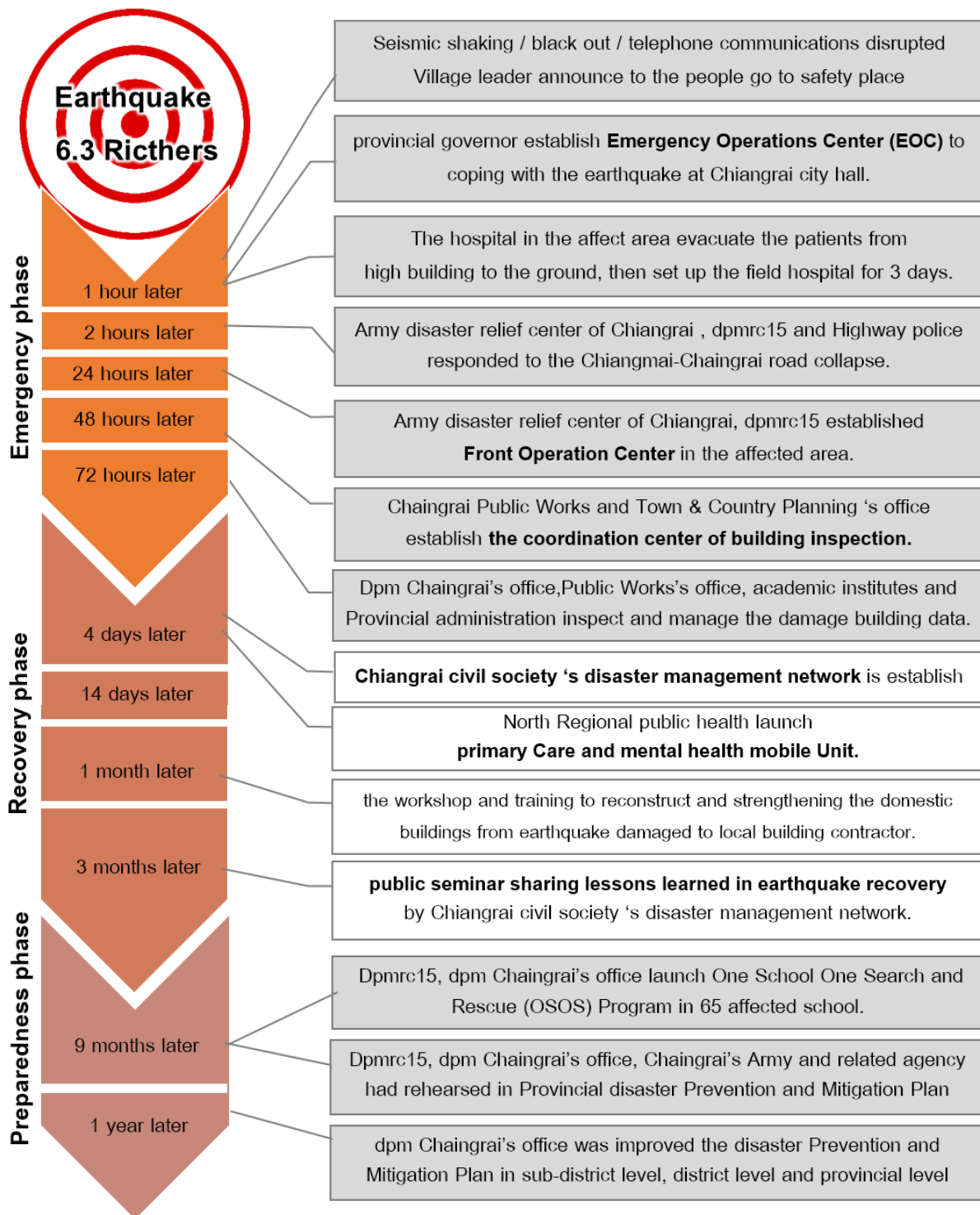
For the qualitative research section, the data was gathered during the 3 months after the earthquake (between May 14<sup>th</sup> to July 27<sup>th</sup>, 2014) from the document, seminar, participant observation and the civil society's knowledge management forum during the recovery phase. The researcher gathered data again during May 2<sup>nd</sup> and July 28<sup>th</sup>, 2015), after 12 months have passed since the disaster occurred, using structured interview with the regional, local and sub-district's agency personnel about the emergency response, disaster mitigation and preparedness

The data were displayed by timeline sequence. The relationship among each organization was defined by the activity such as resources allocation, communication and information exchange. All interactions during the recovery phase were analyzed in the form of social network analysis. And the network graph was displayed by NodeXL Excel Template 2014 version 1.0.1.340 with un-direct type and Harel-Koren Fast Multiscale layout algorithm. The topology of the connection was then examined by social network analysis, in order to formulate the guideline to adjust the role and interaction among the organization in disaster management.

## 3. Results

### 3.1 The timeline of disaster operations

The main organizations of emergency response mobilized their roles following the earthquake and building collapse of Chaingrai provine's action plan B.E. 2557 (2014). In this case, Chiangrai provincial governor declared the public hazard severity as level 2 (moderate), which required the provincial governor to control the situation. Then, the communication and resource allocation were controlled by the provincial's organization in the vertical coordination of response actions ( Chiangrai disaster prevention and Mitigation Office. 2 014) and the horizontal coordination from the individual, private sector and civil society along 3 phases of the operations as figure 1.



**Figure 1** agencies response and disaster management in 2014 Chiangrai earthquake

**Emergency response** (72 hours) 5 May 2014, immediately after the earthquake, most people evacuated from the building to outdoor area. The village leader announced to the people turned off the electricity and water, and move to the safe place. Ten minutes after that the electricity was black out, telephone communication was disrupted. During the first hour,

provincial governor established **Emergency Operations Center (EOC)** as Chiang Rai Earthquake Administration Center to cope with the earthquake and collapse building problem at Chiangrai city hall. Meanwhile the people at the provincial hospital and district hospital in affected area were hesitated to use the high-rise building during the aftershock. Thus the army and district personnel helped the hospital to relocate the patients and medical appliance from indoor to outdoor. Then the field hospital were deployed at the park besides the building for 3 days.

In the first 24 hours, the amateur radio of Highways rescue was informed that the quake caused the highway from Chiang Rai to Chiang Mai collapsed 500 meters stretch. The road shoulder along Mae-lao river 200 meters in Maesuai district also collapsed. The highway was still open to traffic but only one lane was passable. Disaster Preparedness and Mitigation (Dpm) Chaingrai's office, Disaster preparedness and mitigation region Chiangrai 15 (Dpmrc15), Army of Chiangrai and Highway police responded to the Chiangmai-Chiangrai road collapse to provided the shelter, drinking water and food. Afterwards Dpmrc15 setup **Front Operation Center** of Chiang Rai Earthquake Administration Center to cope with the earthquake and building collapsed problem at Huysanyao temple, Dongmada sub-district, Mae-lao district. While Army of Chiangrai setup Front Operation Center of **Army disaster relief center of Chiangrai** at Maelaowitayakom school, Dongmada sub-district, Maelao district. Then the Minister of Interior and Transportation joined the area to survey damages in Maesuai dam, Maesuai sub-district, Maesuai district as well as inspect the structural engineering safety.

Within the first 48 hours, Chiangrai Public Works and Town & Country Planning's office had established **the coordination center of building inspection** at Chiangrai Public Works and Town & Country Planning 's office. Academic institutes and Engineer volunteer flew into the affected area to survey and inspect the damaged buildings. The information of building inspection started with hard copy in paper database from the first 72 hours operation.

As mentioned above, the operation in emergency phase were systematic because the procedures and the personnel's duties were provided prior to the event, following basic needs aid. (Department of Disaster Prevention and Mitigation. 2010), in which the emergency support must be provide in this manner ;

**First 24 hours** food, drinking water, cloth, health, rescue, collect situation data

**24 - 48 hours** shelter, properties, facilities, find missing person, body recovery, etc.

**48 - 72 hours** loss assessment, primary relief, pay compensation money, etc.

**72 hours and long-term recovery** finding victim, social welfare, job rehabilitation, housing, impact assessment, etc.

**Recovery phase** (4 days – 3 months after) when the urgency declined, **the primary Care and mental health mobile Unit** was launched by the public health in the north region. While TV media broadcasted the situation to the rest of the country, the help and donation were

brought to the affected area and Chiang Rai Earthquake Administration Center. The building inspection and building damage data were operated by the academic supporting of engineering volunteer from Engineering Institute of Thailand and many academics institutes (EIT). Thus the main information exchanged among the relief agency in this phase was the building safety assessment data. This information was important to the demolition and reconstruction mission. But Dpm's Chiangrai office didn't used this data to distribute the housing compensation money, while the Dpm's Chiangrai office needed the data of the reconstruction cost assessment. Apparently, there was the lack of an electronic platform which compiled the data from each agency together. The Sub-district Administration office (SAO) in 7 affected district had to assess and gather the data in the area they were in charge of and send it to the district's disaster administration board to approve, then forward it to the Dpm's Chiangrai office. Therefore, these recovery process took time and confuse the victims due to the many steps in the process such as the assessment, the data gathering, and the verification. The relationship among the agencies at local and provincial level were of the command and control pattern, and this routine pattern made data collection overlapping.

In this phase, the workshop and training to reconstruct and strengthen the domestic buildings from earthquake damaged to local building contractor were launched by Chiangrai civil society's disaster management network, Chiangrai provincial Administration Organization (PAO) and Chiangrai Public Works and Town & Country Planning 's office. The construction materials of the workshop were supported by the donation which ThaiPBS (mass media) had mediated from the donors to Chiangrai civil society's disaster management network. As the mass media organization, ThaiPBS had an important role of educating the public of the earthquake phenomena and the solution to assess the safety of the building. As a mediator, it was a part of the conflict resolution among the government and the people by acting as the public forum to discuss the risk and safety of Maesuai dam. Moreover, ThaiPBS was also a part of the actors who create and expand the lesson learnt from community recovery process by operating the workshop to the other recovery community.

**Preparedness phase** (3 months – 1 year after the earthquake) after the basic need and building reconstruction mission were completed. In the 7<sup>th</sup> month after the earthquake, preparedness process, started with One School One Search and Rescue (OSOS) Program in 65 affected school, was launched by Dpm's Chiangrai office and Dpmrc15.

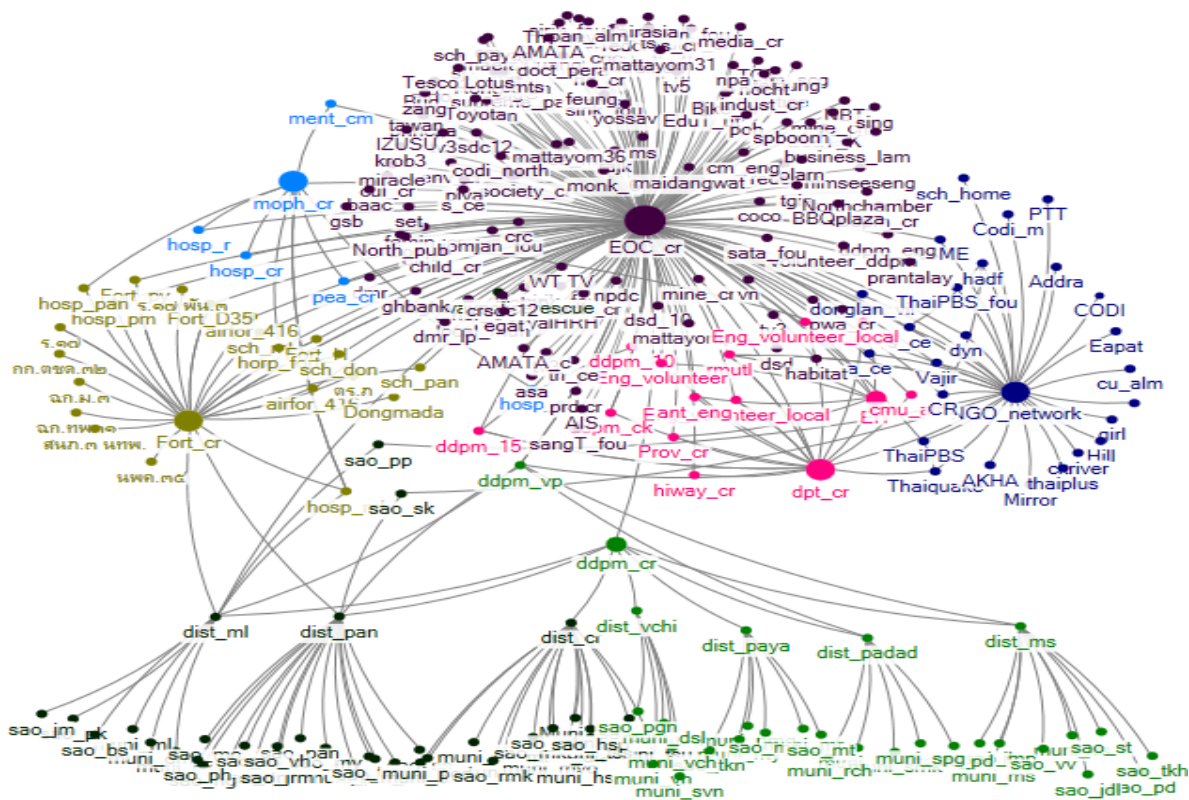
2-6 March 2015, Dpmrc15, Dpm Chaingrai's office, Chaingrai's Army and related agency had rehearsed in Provincial disaster Prevention and Mitigation Plan on incident command system (ICS). This rehearsal was the integrated plan and Joint coordination system command with Thai army in code JDMX 2015 and CREX 2015.

May 2015 (1year later) Dpm Chiangrai's office was informed by Ddpm to improve the disaster Prevention and Mitigation Plan in sub-district level, district level and provincial level

following the National disaster prevention and mitigation plan 2015. This improvement finished in 31 July 2015.

#### 4. Social network analysis in Chiangrai disaster response.

By identifying the interaction of each actor in the response agency in Chiangrai earthquake and matching the relations among actors which exchanged the data or allocated their resource to cope with the disaster, it was found that the topographic of the relationship during the emergency and recovery phase was the STAR pattern as figure 2.



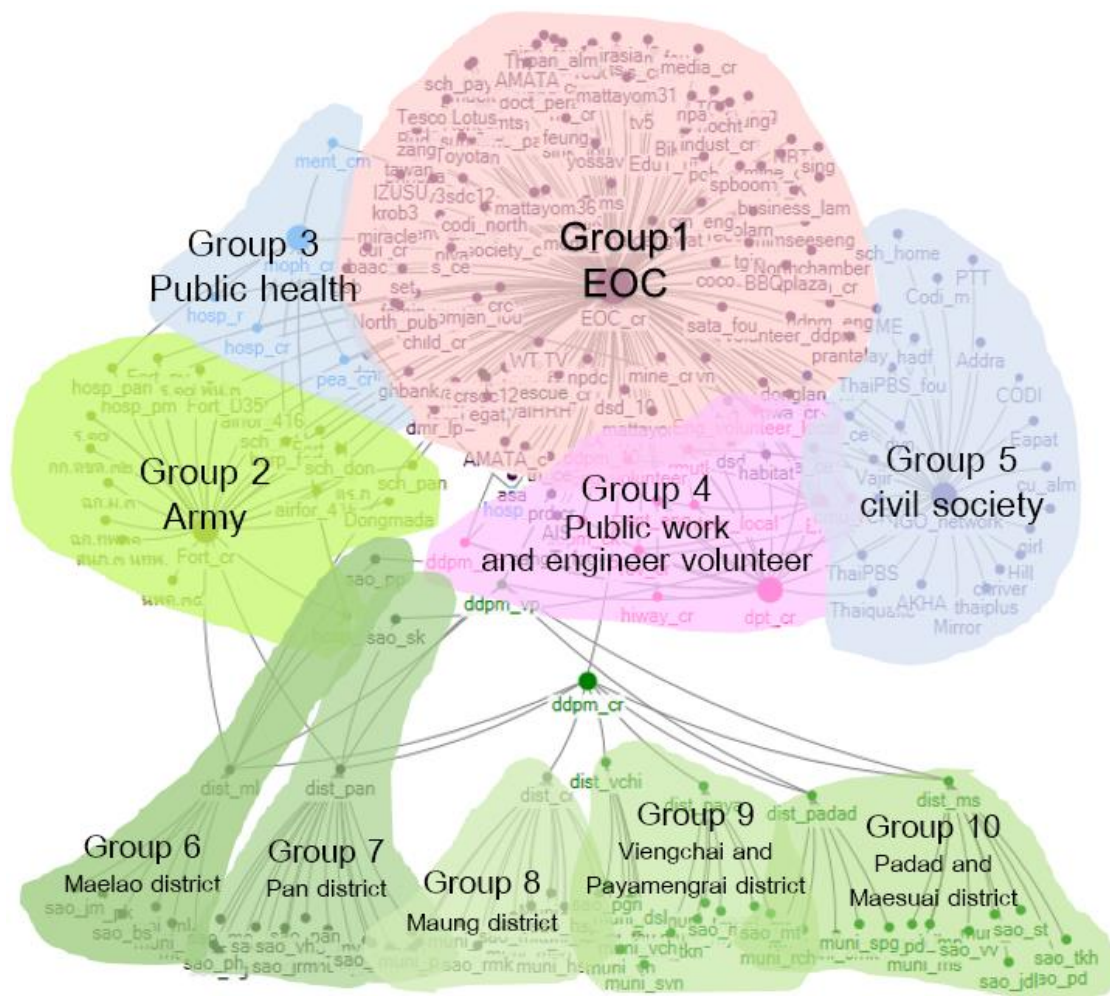
**Figure 2** Social network analysis of the inter-organization in Chiangrai earthquake response

Due to the hazard severity was level 2 which announced from Chiangrai provincial governor. **Chiangrai Earthquake Administration Center** which was Provincial EOC had an authority to command and control the local affected area. In this case, The position of Provincial EOC was the central of the network. The Provincial EOC and PAO were able to directly take action such as provided the vehicle and the machine in charge, while the Army disaster relief center of Chiangrai also supported manpower and machine to remove and demolish the damaged building. From emergency to recovery phase, The Provincial EOC was coping with the earthquake and collapse building problem. While the civil society volunteer, academic institute, NGOs and the coordination center of building inspection were either

mediators or joint of the network. Overall, there were 265, with 355 interaction in this network. The classification of the interaction from social network analysis topology resulted in figure 3, which were 10 cluster relations as following;

- **Group 1 EOC:** Chiangrai Earthquake Administration Center to cope with the earthquake and collapse building problems with donor and related supporter.
- **Group 2 Army:** Army disaster relief center of Chiangrai with army hospital and others related unit.
- **Group 3 Public health:** Chiangrai Provincial and North regional public health and others related hospital.
- **Group 4 Public work and engineer volunteer:** the coordination center of building inspection at Chiangrai Public Works and Town & Country Planning's office, engineering volunteer club, Engineering Institute of Thailand, academics institute and others related unit.
- **Group 5 civil society:** Chiangrai civil society's disaster management network *and* others related unit.
- **Group 6 Maelao district:** Maelao district office with sub-district administration office.
- **Group 7 Pan district:** Pan district office with sub-district administration office.
- **Group 8 Maung district:** Maung district office with sub-district administration office.
- **Group 9 Viengchai and Payamengrai district:** Viengchai and Payamengrai district office with sub-district administration office.
- **Group 10 Padad and Maesuai district:** Padad and Maesuai district office with sub-district administration office.





**Figure 3** The cluster divided in social network analysis from Chiangrai earthquake response

**Group 1, 2 and 3** are the linkages during the emergency phase through direct coordination on situation evaluate and resources allocation responding the extreme event in the affected area. **Group 6** Maeloa district and **Group 7** Pan district which the road collapsed on Chiangrai-Chiangmai route were settled as the front operation center. The core group of this network was Chiang Rai Earthquake Administration Center to cope with the earthquake and collapse building problem at Chiangrai city hall, which centralized the evaluation of situation and resources allocation for rehabilitation.

**Group 3** responded as the Public health, Medical and Mental health services. This group coped with the internal chaos within the hospital, due to the concern about the safety in high-rise building. The hospital had to control the chaos by evacuating the patients and the equipment down to the outdoor area and setup the field-hospital there. Thus, Group 6,7 were linked to Group 1, 2 and 3 from field-hospital set up in Maelao hospital and Pan hospital.

**Group 4 and 5** are linkages with the role of the building inspection. The most civil engineer specialist came from the Engineering Institute of Thailand cooperation. The cooperation center

of building inspection was supported by the independent unit as website ThaiQuake in group 5 to provide the information system for the building inspection database.

**Group 6, 7, 8, 9, 10** are district office and sub-district administration office from 7 affected district. The interaction between affected area and supporters varied by severity of hazard such as Maelao, Pan, Maesuai and Padad district (Group 6,7,10), which were announced to area closed to the earthquake epicenter. Then, the emergency aid followed the information which report the loss and the situation for the better decision of supporters. While Maung district (Group 8), Viengchai and Payamengrai district (Group 9) shared the similar geography of being far from the earthquake epicenter. Thus, the report of loss and damage were less than Maelao district and Pan district, Therefore the interaction between supporter and group 8,9 are less than other group.

This social network analysis graph indicated that the center of the network is Group 1 EOC which are the coordination with the front operation center, the donor and the supporter organization. This EOC was the most influential inter-organization relation because the role of EOC can be the center, the node and the bridge of the network. While Chiangrai dpm office influenced to the network as the bridge between EOC and SAO. Army disaster relief center of Chiangrai, the coordination center of building inspection was important as the node of the network which link the margin actor in affected area through the inspection building survey, similar to the Chiangrai civil society's disaster management network interaction which has the activity in the workshop and training to reconstruct and strengthening the domestic buildings from earthquake damaged to local building contractor to the local building contractor.

Finally, the margin actors were SAO from the affected sub-district which far from the center. These actors also had the problem in resource allocation among SAO and the redundant process of compensation reimbursement, which required assessing the damage by village leader and SAO committee, data gathering at SAO, verification of the data from SAO at district office and sending all data to Chiangrai dpm office and EOC, before the money can be sent to the affected SAO distribute.

## **5. Conclusion and Discussion**

Topology of Chiangrai earthquake response network is the mixed pattern of “the star” and “the tree”. Due to this public hazard severity was announced in level 2 by Chiangrai provincial governor, Provincial EOC had the duty to command and control local affect area in charge. Thus, the operation structure was centralized from Provincial EOC to local area. Local administration office as SAO were dependency actors who request for the machine and manpower in rehabilitate mission from EOC (the central of the network) and Army disaster

relief center which coordinated overlapping in emergency phase. While the academic institute, civil society and volunteer were the mediate actors among EOC and affected area.

However, during the recovery phase, the relationship in each agency actors were independent, as they operated their own procedure in separate order. This led to the problems which delayed recovery to the affected area, such as the complicated of recovery process which facing with bottleneck problems during data gathering step. The coordination across the agency, the function, the jurisdictions were complicated because each agency did not have the shared database systems. Thus the mutual aid among SAO, PAO and support agency were limit because they didn't have the information those who were in need and resource to exchange or matching them together.

The suggestion which are considering with Department of Disaster Prevention and Mitigation Strategy Plan B.E. 2555-2559 (2012-2016) to support the disaster preparedness are;

- 1) the inter-organization relations in recovery phase must change from vertical to horizontal direction.** The practical problem from the affected area should have more chance to reflex. The command and control strategies (top-down process) should be decreased. "The mutual aid agreement" as sub-district – sub-district mutual aid might be a local multiagency plan to increase the flexibility and adaptability during dynamic situation (Richard Sylves, 2008). Meanwhile, support and raise the awareness through "community based disaster risk management (CBDRM)" which will increase the self-organize capacity to the local.
- 2) Main provincial agency should utilize an appropriate technology to manage the information as "National single window" which difference agencies are able to access the data.** The pool of electronics information database might get a chance to crossover the database such as integrated a seismic mapping with damage building location information or the loss and the risk of the properties together.
- 3) Main provincial agency must be strict with the building code enforcement** and put more emphasized in the education on the reconstruct and strengthening the domestic buildings from earthquake damaged to local building contractor.

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