The Conceptual Framework of Development Needs Prediction Model for Aid Goods of Earthquake Relief

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Abstract - **Humanitarian supply chain management has attracted research attention in the recent years. In this paper, we investigate the literature to mapping and identify potential research directions in humanitarian logistics planning for disaster management, and provide a starting point for interested researchers. This paper will serve as a guide to researchers who would like to know how disasters, logistics of emergency response and how to predict aid goods should be prepared for disaster relief. The purpose of this paper is not only review the literature to describe the current practices and research trends in logistics of emergency response but also provides the conceptual framework of development needs prediction model for aid goods of earthquake relief.**

Keywords − **needs prediction, damage prediction, loss prediction, and humanitarian logistics.**

I. INTRODUCTION

Indonesia occupies a very active tectonic zone because of three major tectonic plates of the world and nine other small plates were met at the territory of Indonesia and forming lines of complex plate meeting [1]. The existence of interactions between the plate place the territory Indonesia as the region is very vulnerable to earthquake disaster [1]. The high of earthquake disaster frequently evidenced by the results of the recording of 1897-2009 there are more than 14,000 earthquakes occurrence with magnitude M > 5.0, [1].

According to data compiled by the National Agency for Disaster Management of Indonesia (BNPB), the total occurrences of natural disasters and non-nature in 2007 is 379 events while in 2008 is 1276 incident, the data shows that there is a rise of more than 3 times the occurrence of a disaster [2]. The Global Assessment Report on Disaster Risk Reduction in 2009, coordinated by UNIDSR (United Nations-International Strategy for Disaster Reduction), states that Indonesia has a value of 10 for the risk of natural disaster earthquakes, flood has the value 5, and landslides have a value of 3, [3]. This was confirmed with the data have been compiled by BNPB, disaster in Indonesia since 1815-2009 suggests that the earthquake disaster is a disaster with the most casualties, though the frequency of occurrence is not often, [4].

In the last six years, has recorded various major earthquake activity in Indonesia, such as Aceh earthquake accompanied by tsunamis in 2004 with magnitude M =

9.2; in 2005 Nias earthquake with magnitude M = 8.7; Yogya earthquake in 2006 with magnitude M = 6.3; Tasikmalaya earthquake in 2009 with magnitude M = 7.4; and lastly Padang earthquake in 2005 with magnitude M = 7.6. The earthquakes have caused thousands of casualties and damages, thousands the collapse of infrastructure and buildings, as well as billions of rupiah funds for rehabilitation and reconstruction [1]. Based on these facts, it can be inferred that the disaster in Indonesia should be prioritized for earthquake disaster.

Earthquake could cause serious disruption for the a society causing widespread loss of human life in terms of material, economic or environmental and sometimes exceeded the capabilities of these disruptions the community to resolve it by using their own resources, so their needed help from other areas. The consequences from disaster are (1) physical damage (lifeline systems, e.g. water, electric power, and transportation systems; structural damage, e.g. building), (2) socio-economic losses (business interruption, change of normative behaviors, increase in tension); and (3) death and injuries (public health issues, psychological issues, death tolls), as in [5]. The relationship among conditions for disaster, characteristics of disaster and consequences from disaster is shown in figure 1.
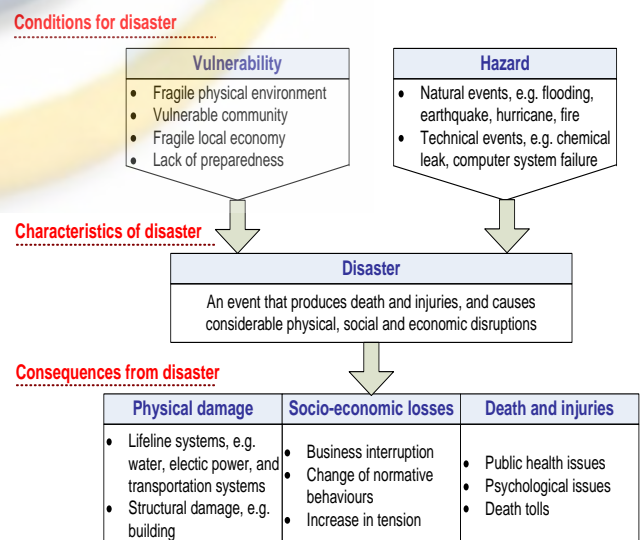

Fig.1. Dimensions of disaster research [Chen, 2010]

II. METHODOLOGY

This research conducted a review of scientific papers that relevant to loss prediction, damage prediction and needs prediction for aid goods of earthquake emergency relief. The tracing scientific papers activity conducted by using e-journal database, e.g: proquest, ebsco, elsevier sciencedirect, and springer. The keywords used in activity of tracing the scientific papers are: "damage prediction", "damage assessment", "loss prediction", "loss assessment", "economic loss prediction", "economic loss assessment", "casualties prediction", "casualties assessment", "needs predictions", "relief logistics" and "humanitarian aid".

Total articles found are 22 relevant papers, these are classified the relevant papers according to the topics covered. The classification of the research topics is divided into 4 topics. Thus topics are: economic loss prediction, casualty prediction, damage prediction and needs prediction. Based on the research mapping on previous step, next step is design the conceptual framework of development needs prediction model for predicting the aid goods of earthquake relief. The scheme of research stage delivered on figure 2.
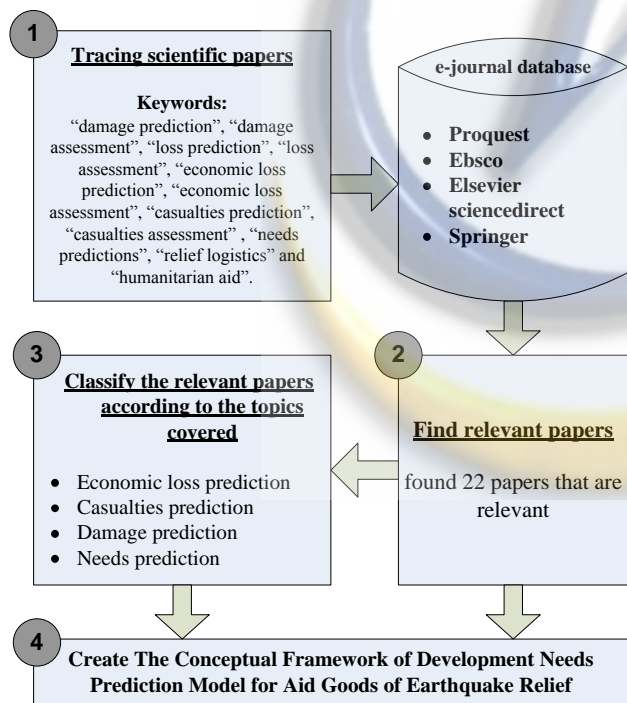

Fig.2. Scheme of research stages

III. RESULTS

The process of prediction on the type and quantity of aids good for earthquake relief can be made when the damage prediction and casualties prediction has been made. Some research in loss and damage prediction has been made by earlier researchers, both studies focus on loss prediction, or focus on damage prediction, or focus on both. Loss prediction in general performed for the economic loss prediction and casualties' prediction.

The research that only focuses on loss prediction has been made by [6], [7], [8], [9], [10], [11] and [12]. While the research that only focus on damage prediction has been made by [6], [7], [8], [13], [9], [14], [15], [16,17], [18], [19], and [20]. While research has focused on both of loss prediction and damage prediction has been made by[21], [22], [23], [24], [25], [26], and [27]. The mapping of the research that mention above can be seen in a schematic image delivered on Figure. 3.
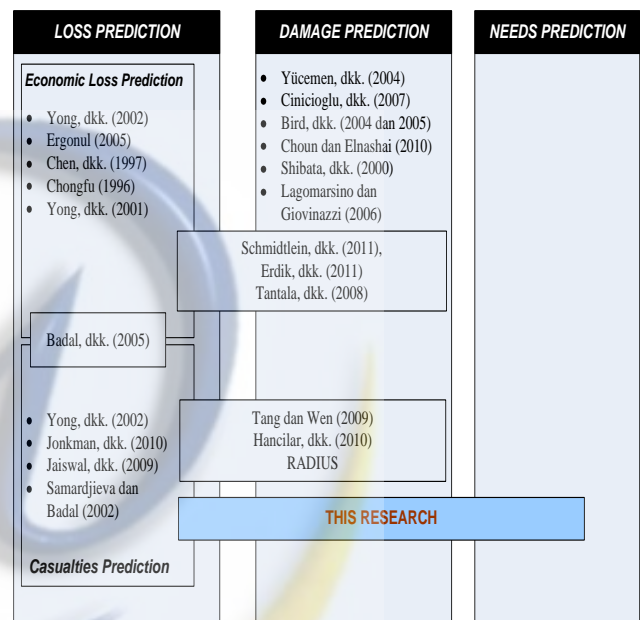

Fig.3. Research mapping

All researches has been done only stopped on the predict the number of victims, the number of losses, the amount of damage or a combination of both, without continued the process of needs prediction for aid goods relief items that needed to alleviate the suffering of victims. Badal, et al. [25], states that the duty of the most important and should be done after the destructive earthquake is helpful and save lives by offering live-saving operations for the rest of the victims were injured and in need of medical services with the aim of reducing the risk to the victim.

Reduction of risk to the victim not only provides medical services, but also to ensure the fulfillments of staple the victims given properly, quickly and accurately. It thus requires a model that can predict the type and quantity of aids goods should be prepared in the relief activities for earthquake disaster emergency response in an attempt to ease the suffering experienced as well as ensuring the needs of disaster victims is fulfills.

Therefore, the problem is formulated in this paper is how to determine the type and quantity of aids goods that needed by disaster victims on the emergency response phase of disasters, in particular in the case of earthquake disaster. Conceptual framework how to develop the model to determine the type and quantity of aids goods that needed by disaster victims delivered on figure 4.
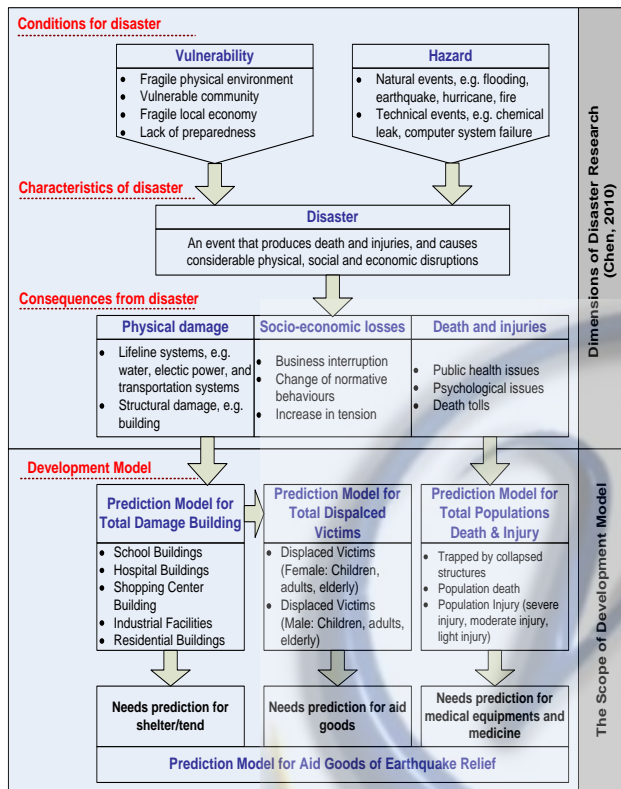

Fig.4. Conceptual framework of development needs prediction model for predicting the aid goods of earthquake relief

To develop the model for determine the type and quantity of aids goods that needed by disaster victims consists of three main models, are:

- **Model 1: Damage prediction model**. This model predicts the total damage building if the earthquake occurs. The Output this model is the result of damage to buildings due to prediction of earthquake disaster happened, i.e. a number of damage for the residential buildings, school building, hospital buildings, shopping center buildings and industrial facilities.

- **Model 2: Displaced prediction model**. This model predicts the total displaced victims if the earthquake occurs. The Output this model is the result of displaced victim either male, female, kids, adults and the elderly.

- **Model 3: Injuries populations' prediction model**. This model predicts the total injuries and death population. Output this model consist of (1) the number victims that trapped by collapsed structures, (2) population death, (3) population injury (severe injury, moderate injury, light injury)

If the three models mention above already well define, the process determine for the type and quantity of aids goods that needed by disaster victims can be started. The aid good prediction model was a continuation of the model 1, model 2, and model. After a well-defined number of damaged buildings, the number of deaths, the number of injured and the number of displaced victims, then the next step is doing calculations and predictions the type and quantity of aids good should be prepared as a responds to devastating earthquake happened, especially in the emergency response phase.

IV. CONCLUSION

The purpose of this paper is not only review the literature to describe the current practices and research trends in logistics of emergency response but also provides the conceptual framework of development needs prediction model for aid goods of earthquake relief.

This paper also will serve as a guide to researchers who would like to develop a model to predict and determine the type and quantity of aids goods that needed by disaster victims on the emergency response phase of the earthquake disasters. So the type and quantity of aids goods can be deliver immediately after the occurrence of the disaster and emergency response activities can be immediately done quickly, precisely and accurately.

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