Chapter 16
Distribution of Humanitarian Aid Through Different Clustering Strategies Using Optimization

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ABSTRACT

Natural disasters produce enormous human and material losses. This is amplified if there is poor relief aid humanitarian distribution. Logistics seeks to obtain efficiencies related to response reducing transportation costs; according to humanitarian institutions, they constitute the second largest general expense after labor. Humanitarian distribution challenges are reduce costs, maintaining distribution service, and designing reliable delivery routes in a context where infrastructures may be non-existent, unavailable, or inoperative. This chapter addresses the problem of optimizing the distribution of humanitarian aid by comparing different clustering strategies for the medicines warehouse in charge of the national hospital services entity in Metropolitan Lima and Callao. The chapter is organized as follows. First, a review of the literature on problem of vehicle routing for resilient networks are presented. Then the proposed model will be shown considering those limitations to humanitarian delivery in a post-disaster context; finally, feasible solutions will be compared.

INTRODUCTION

According to (Wijkman A., 1984), natural disasters are events that refer to the enormous human and material losses, other definitions such as those of (Cuny, 1983) affirm that the effects of a disaster could be amplified if it exists poor human settlements planning, poor security measures, poor emergency plans and lack of early warning systems, in short, poor preparation to deal with these events. That is why it is necessary to act quickly and efficiently to prevent further pos disaster events from affecting more people.

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Emergency relief operations, logistics are required to support the organization and implementation of response operations to ensure their timeliness and efficiency. Mobilizing the staff, equipment and goods of humanitarian assistance organizations, the evacuation of the injured or the resettlement of those directly affected by the disaster, requires a logistics system to maximize effectiveness (PAHO, 2017). The relief of the victims and the allocation of humanitarian personnel plays a leading role in these events (Caritas, 2009). Pedraza-Martinez, Stapleton, & Van Wassenhove (2011) confirms that transport is the second largest general budget of humanitarian organizations after staff. In Peru, governmental institution in charge of these activities is the National Institute of Civil Defense, INDECI (INDECI, 2003; PNUD, 2011). Medical supplies to be used in Lima's disaster cases INDECI have pre-set two Central Warehouses (AC) by INDECI. Humanitarian response recognizes two phases after a disaster: the reaction and the recovery (Alexander (2002). In Thévenaz and Resodihardjo (2010), authors show a two-stage process; the life-saving and the life-sustaining actions. The first one consists in carrying out activities that aim to preserve life, such as the removal of debris and the rescue of victims. The second one involves the provision and supply of aid kits and services such as food, water, temporary shelter, medical care and protection (UNDAC, 2006). This paper tackles the problem of last mile distribution for medical humanitarian relief, which seek manage aid relief (medicines) transport from Central Depots (ACs) to Medical Local Supplies (AMs). Vulnerability factors which represent current state in the location affected is considered as model's inputs. Different VRP techniques to solve the problem are applied after application of clustering methods are considered to evaluate for minimal routing cost. Different operative results are considered to achieve feasible solutions considering minimal time to disaster victims' attendance. This paper is arranged as follows: the next chapter presents a review about areas exposed to earthquakes in Lima and its districts. Then, four-path methodology is presented to determine vehicles assignment. At the end, results and discussion are exposed; mains criteria about assignment of cargo, number of trips and vehicles assignment are presented. Finally, the conclusions and future research are proposed.

HUMANITARIAN INTERVENTION

An intervention is considered effective when victims are rescued from life-threatening conditions. Otherwise, a crisis may result in an event called second disaster (UNHCR, 2007). For instance, an improper burial of corpses could result in an infectious disease, killing the remaining survivors.

The widespread premise that humanitarian response cannot achieve its goals without a well-performing logistics is based on the field results received by humanitarian entities on disaster intervention. Gatignon, Van-Wassenhove, and Charles (2010) remark that during the Yogyakarta's earthquake, the International Federation of Red Cross and Red Crescent Societies (IFRC) implemented a decentralized logistics management called the three B's of the supply chain excellence: Bucks (money), Bytes (information) and Boxes (material), which is an efficient, fast and cheap supply chain. A decentralized supply chain means an intensive usage of pre-established depots. About them, Harrison and van Hoek (2008)] say that the right location of finished goods is a well-known way of responding quickly to the demand that has emerged. Also, Baker (2008) mentions that in most companies, distribution centers constitute the key to keeping a good service level for their end customer. In the same context, Frazelle (2002) confirms that for logistics operations, in many companies the distribution centers are critical to success or failure in attending their markets. Moreover, in the supply context, in Klibi and Martel (2012), the authors say that random customer orders are fulfilled from pre-assigned depots using different transportation. In addition,