

# Proposal of a concept of local logistics units for humanitarian relief operations and identification of criteria to better choose their installation site and their relevance

Karima Zejli, Abdellah Azmani, Mustapha Erriani

**Abstract**— The various major players of the humanitarian aid (IFCR, ICRC, PAHO), prompt to the decentralization of the logistics of help (rescue) by creating local logistical units in complement to the regional logistical units (RLU), which role is to centralize the humanitarian interventions of scale and their mutualized management. From this perspective, we developed the premises of a new ecosystem proposing an architecture joining several types of local units (Proximity Logistical Unit: PLU, Potentially Useful Site: PUS). These can play an important role in the reactivity of supports and rescue interventions, and be in most of cases sufficient to face a situation of disaster or when the latter is large-scale worked in accordance with an RLU. The implementation of such an ecosystem supposes several considerations of which the wise choice of the geolocalization of a regional logistical unit, its role and its dispositions.

**Index Terms**— Ecosystem humanitarian logistics, regional logistical units, local logistical units, proximity logistical unit, potentially useful site, location of proximity logistical unit, relevance of potentially useful site.

## 1 INTRODUCTION

The establishment of Regional Logistical Units (RLUs), placed and managed across the globe, by international organizations such as the Red Cross Red Crescent International Federation (IFCR), the International Federation of the Red Cross (ICRC), the Pan American Health Organization (PAHO), provides a concrete response to better face disasters and optimize logistical aspects that minimize the impact of the latter.

However, those RLU(s) are still too far from local communities in terms of culture, knowledge and geographical distance. It is for this very reason that organizations such as the IFCR, ICRC or PAHO have developed an integrated local stock strategy, as actions with local stocks would enable to significantly improve their interventions [1]. RLU(s) dedicated to those large-scale rescue interventions characterizes a central logistical system, so-called regional. We are particularly interested in this article in highlighting the obvious choice of the principle of a decentralized system, so-called local, managed by the rescues' stakeholders Local humanitarians and/or the States of the concerned countries. Accordingly, we present the decentralization principle by proposing the concept of Proximity Logistical Unit (PLU) and that of the Potentially Useful Site (PUS). These type of logistical units shall form along with the RLUs a new ecosystem that brings a new dynamic to humanitarian aid, for a better efficiency in terms of results and em-

powerment of the potentially threatened population.

The choice of the location of such logistic units and buildings, appropriate to play a role in the value chain of a humanitarian rescue operations, must be properly made in order to favor humanitarian rescue interventions in a relatively tolerable time. We seek to identify, classify and prioritize all the criteria and parameters that will enable us to come up with a method of decision support for the choice of locations of humanitarian logistics warehouses according to the nature of the roles that we intend to assign to them.

## 2 RESEARCH PROBLEM AND STAKES

The aim of the response to disasters in the humanitarian supply chain is to quickly supply emergency food, potable water, medication, shelters and supplies in zones that are affected by large scale emergencies, so as to minimize the human suffering and avoid a large number of deaths [2]. Consequently, the conception and the functioning of the humanitarian supply chain play a significant role in the realization of an effective and efficient answer to deal with any crisis caused by any kind of disaster.

Thereby, the establishment of local warehouses, closer to zones exposed to disasters, has for global objective shortening the time of response [3] which contributes to an enormous reduction of the complexity of response to disasters.

The stakes of such a measure could turn out to be very advantageous, namely:

- Karima Zejli, Laboratory Mathematics and Applications (LMA), Faculty of Science and Technology (FST), Tangier, Morocco.
- Abdellah Azmani, Laboratory of Sciences Computer, Systems and Telecommunication (LIST) Faculty of Science and Technology (FST), Tangier, Morocco.
- Mustapha Erriani, Laboratory Mathematics and Applications (LMA), Faculty of Science and Technology (FST), Tangier, Morocco.

- Better reactivity thanks to the availability of a minimum utilization of equipments, tools and products which come along with short delivery deadlines.
- Reduction of costs, in particular the reduced costs of transport and the presence of local skills.
- Administrative ease because local deliveries require less documentation compared to international shipments.
- Support and implication of the local economy: increase of the level of local preparation (processes, products and defined partnerships) by the predictability of local purchases seen in the required quality.

Local capacity of construction: which is translated by the training of qualified staff and the development of local expertise in order to make better anticipations and be well prepared to face possible disasters.

Having local stocks has to, necessarily, come along with the implementation of a management of knowledge policy, in order to develop the local capacity that will help maintain local stocks and reduce the impact of high turnover of human resources in the humanitarian field. Furthermore, it is judged necessary to train a national staff to be able to take care of some responsibilities and preserve the past experiences [3].

### 3 DECENTRALISATION OF THE HUMANITARIAN SUPPLY CHAIN

A humanitarian logistical system must shorten its time of response, in order to allow humanitarian institutions that provide help to be able to intervene in a fast and reactive manner during the first episode of a disaster [4].

Rescue operations and humanitarian aid can reduce, significantly, risks and dramatic consequences of a disaster, as well as the scale of a crisis in order to ease its management.

Despite the fact that RLU(s) are capital in the process of centralizing rescue operations of the large-scale, they don't unfortunately allow, in most of cases, the international organizations of rescue, to be highly reactive, neither to face the scale of a disaster alone, neither to answer all needs, nor to organize their operations during a reasonable deadline. Indeed, it was underlined that RLU(s) that are geographically closer to regions often affected by disasters remain insufficient because of their cultural, level of knowledge, and geographical distance from local communities [1].

This underlines the necessity of having alternative solutions, either to bring synergy to international institutions of humanitarian aid, or to face disasters of less important scale, but nevertheless dangerous, that can be managed locally by Non-Governmental Organization (NGO), associations and national players.

Moreover, effectively speaking, the elaboration of logistical

solutions close to the threatened zones could be less expensive and play a key role regarding the first interventions in order to bring first aid and care, in particular for places difficult to access, and in case a disaster badly isolates a population.

It is with respect to this logic above that we opt for a smoother and cheaper solution which entails fewer risks and which can have a primordial role during the first episode of a disaster. It is the implementation of two complementary concepts to RLU(s), namely:

- Proximity Logistical Unit (PLU)
- Potentially Useful Site (PUS).

The PLU is a logistics unit dedicated to a single activity of which the implementation and the management are flexible.

It should preferably be entrusted to an NGO or a local community and, if necessary, to an authority that administers the locality where it is located (provincial governor or municipality).

The PLU must not require a large investment and its operation must be very affordable and funded through grants, international donations or local donations.

Such a unit can occupy a space of 4m<sup>3</sup> to 100 m<sup>3</sup>. There may even be mobile units of the container type which can, if necessary, be towed by a vehicle. Similarly, some units can be buried in the ground, well protected from the effects of nature while their location may be kept confidential and protected.

A PLU depending on its size can be dedicated to the storage of the following items:

- Excavation and the clearing equipment: excavator, clearing machine, ...
- Equipment and consumable energy: Generator, gas, oil, battery, ...
- First aid and shelter equipment: Vest, Mask, Thermal blankets, tents, camp beds, stove, ...
- Sanitary equipment: water filter, sterilizers, ...
- Various products: Foods, candles, lighters, ...
- Drinking water supply.

A Potentially Useful Site (PUS) may correspond to a public or a private building (sports hall, school, museum, station, indoor market, ...) or a sports field, a garden, a wasteland, ...

These are existing sites that are predisposed to be requisitioned and that may be auspicious and relevant during a disaster.

Their main vocation is the reception of the victims, the wounded, the homeless, the inhabitants or even the rescue teams. An PUS can eventually be used to set up a local head-

quarters to centralize the management of a crisis.

Depending on its size, its geolocation, its low degree of vulnerability, a PUS can integrate one or more PLU, fixed or Mobiles (preferably not more than 40m<sup>3</sup>), in particular for the storage of medicines, sanitary products, beds camps, long-term food, light equipment and tools.

Specific conditions are necessary especially for PLUs:

- Make a smart and intelligent choice of PLU locations and the relevance of PUSs.
- Prepare and train local NGOs to develop knowledge and skills in the management and logistics of PLUs.
- Train local associations to properly manage the first crisis situations and make their contribution with the arrival of national and / or international humanitarian organizations.
- Training of the local population to develop skills in first aid, excavation and maintenance of resources and places.
- Sensitize and empower the local population to avoid any act of vandalism or burglary of pre-installed goods or pre-deposit in the PLU.
- Find fundings for:
  - The necessary investments for the development and equipment of PLUs and PUSs.
  - The operating of the PLUs and the renewal of stocks.
  - The Studies and the actions of trainings and consciousness raising (awareness).

#### 4 WISE LOCALIZATION OF LOCAL LOGISTICS UNITS

Whatever the type of Logistics Unit chosen PLU or PUS, a fundamental question is needed: where should it be geolocated and positioned?

The choice of a specific place must be done wisely judiciously and can not be arbitrary. Such a decision can not be made hastily, and several parameters must be taken into account, to justify the choice of a site on the basis of a concrete and scientific argument. We have been able to highlight a number of criteria that must be taken into consideration in order to geolocate and position a unit dedicated to humanitarian logistics. These criteria were identified, ranked, classed and prioritized (Table 1 for PLUs and Table 3 for PUSs).

##### 4.1 How to choose the most suitable site for PLU?

A PLU is an agile solution to the problems of humanitarian logistics because it is easier to set up, it is easily movable, less expensive, and complementary to other PLUs (or even altogether to RLUs). It is also a sustainable solution, reusable and

allows to associate with its management the local actors or to empower the population that is in a vulnerable area.

There are 2 categories of PLU:

- Small container size (no more than ten cubic meters), mobile or towable, intended to be implanted or buried in a risk zone: a neighborhood junction, public garden or private garden, courtyards of an institution. A PLU in this category has as its specific objective the possibility of bringing to a population affected by a disaster, a set of elements that can help them cope with it during the moments that announce and follow the beginnings of the disaster. It is particularly useful during the onset of an impending disaster and the onset of the crisis. A PLU is often equipped with a small stock of drug products, first aid tools and small equipment needed for the first rescue operations, a generator, small hydraulic pumps, a water filter. water, batteries and sometimes specialized food and water.
- Those of larger sizes (about a hundred m<sup>3</sup>) of type (industrial building or bunker) and which must be located near a risk zone (between 20 km and 50 km). These contain the same type of items but in a larger size and quantity.

Regarding to the criteria related to the choice of the ideal location of a PLU, we propose in Table 1 a summary of a structure organized by "Category, Criterion and sub-criteria" which have a coefficient which characterizes their importance on the basis of Table 2.

TABLE 1

CRITERIA'S CLASSIFICATION TO HELP LOCATE THE MOST RELEVANT SITE TO HOST A PLU

Category, Criteria or Sub-Criteria	coef-ficient
<b>Knowledge and skills</b>	<b>3</b>
<b>Availability and quality of skills</b>	<b>3</b>
Skills in humanitarian logistics	3
Competence in logistics	2
Management competence and conduct of teams	2
Telecommunication Competence	1
Computer skills	1
Rescue skills	3
Competence in Medicine and Nursing	3
Other skills that converge with humanitarian aid and logistics management	2
<b>Local actors support and contribution efforts</b>	<b>2</b>
<b>Financial contributions</b>	<b>2</b>
Contribution to the investment	2
Contribution to the running costs	3
<b>Support</b>	<b>2</b>
Political will to host a PLU	3
Donation of equipment and machinery	2
Minimal stock donation	2
NGO locales	2
Proximity to the beneficiaries	1
Degree of Accountability	1

<b>Geolocation status</b>	<b>3</b>
<b>Environmental criteria</b>	<b>3</b>
Relevant position in or near neighborhoods of a potentially unsettling area	3
Easy accessibility	3
Ability to respond quickly to certain situations of rescue or first aid	2
Protected and Secure Location	1
<b>Logistics Criteria</b>	<b>2</b>
Flexibility to respond to the demands of the victims	3
<b>Cost</b>	<b>1</b>
Operating cost	1
Security Cost	1
Training Cost	1
Purchase Cost	1
Administrative procedures Cost	1
Transport and Logistics Cost	1

TABLE 2

PRINCIPLE OF THE EVALUATION OF AN ORDER OF PRIORITY OR IMPORTANCE BETWEEN CATEGORIES OF CRITERIA, CRITERIA AND SUB-CRITERIA

Importance coefficient	Qualitative Value
3	Very important
2	Important
1	less important

#### 4.2 How to choose the most suitable places for PUS?

Unlike logistics units, a potentially useful site is already geolocated. It is a vacant lot, a covered or uncovered sport field, a health facility, a public or privatized garden, a school, cultural, religious or public or private building or building with more or less space and provisions for disaster victims, or rescue and crisis management teams.

Generally an PUS is intended for the reception of the homeless, wounded, people in the habitat is threatened or destroyed. The preventive choice of such a site makes it possible to develop it well and pre-equipped in particular by small PLU (s).

Table 3 illustrates the set of criteria and their subcriteria that must be taken into consideration when pre-selecting a PUS in order to make a smart and predictive choice.

TABLE 3

Criteria to be considered for pre-selecting a PUS

Category, Criteria or Sub-Criteria	coefficient
<b>Local actors support and contribution efforts</b>	<b>2</b>
<b>Support</b>	<b>2</b>
Political or civic will to welcome an PUS	2
<b>Geolocation status</b>	<b>3</b>
<b>Environmental criteria</b>	<b>3</b>
Relevant position in or near neighborhoods of	3

a potentially unsettling area	
Easy accessibility	3
Ability to respond quickly to certain situations of rescue or first aid	2
Protected and Secure Location	1
<b>Architectural criteria</b>	<b>2</b>
Available space	2
Accommodation capacity	3
Strength of the building and its construction according to the seismic norms	3
Specific arrangement (ventilation, sanitary, infirmary, ...)	2

However, the use of an PUS can only be confirmed at the first sign of a foreseeable disaster or during the onset of a disaster. This choice is made on the basis of pre-selected sites which respect the following conditions:

- Building not touched.
- Accessibility possible.
- Electrical installation intact.

As well as the following criteria:

- Site in less risky zone but within a radius of less than 20 km from affected areas (Coef. 2).
- Presence of water or water sources (coef 3).
- Pre-development with equipment and products needed for reception, medication and emergency first aid (coef 3).
- Other relevant elements (Coef 1).

#### 4.3 How to evaluate a site for PLU or PUS?

In order to evaluate a site, the following Equation (1) presents a generic and simplistic form.

$$SV(x) = \text{The value of the site } x$$

$$SV(x) = \sum_{i=1}^M \alpha_i \sum_{j=1}^{N/i} \beta_j \sum_{k=1}^{P/j} \delta_k v_k \quad (1)$$

M : number of category criteria

N : number of criteria within one category "i"

P : number of sub-criteria within one criterion "j"

$\alpha_i$  : coefficient related to category "i"

$\beta_j$  : coefficient related to criterion "j"

$\delta_k$  : coefficient related to sub-criterion "k"

V : value attributed to one sub-criteria

For an effective and logical evaluation, quantification of the coefficients  $\alpha$ ,  $\beta$ ,  $\delta$ , as well as that of the values V, is to be made using scientific methods of which we dedicate ourselves



at present. Our scientific literature investigations show that two main approaches are proposed to handle location problems and choosing a suited site for a specific installation:

- **The quantitative approach:** in this approach, only objective criteria are considered, which are very often translated into cost criterion. The objective is to find the less costly solution. The most used methods to address this approach are those of mathematical optimization (MOM).
- **The qualitative approach:** it consists of choosing sites that best satisfy decision criteria. These criteria can be either qualitative (subjective) or quantitative (objective). To this end multiple-criteria decision-making (MCDM) methods are very often used [5].

Multi-criteria analysis aims at providing decision makers with tools that allow them to resolve a decision problem in which several points of view, often contradictory, must be taken into account [6]. Using a MCDM method is imperative for resolving decision problems because of its realism and the simplicity of its implementation, compared to other methods that demand hard work at an early stage, very time consuming, very costly and which does not consider uncertainty.

## 5 CONCLUSION

In this article we have sought to highlight the need to establish local logistic units humanitarian aid type PLU or PUS, particularly useful in endangered areas, and whose choice of place of installation must comply with specific criteria. The latter have been presented with a coefficient to rank them according to their degree of importance. To find the right location for a PLU and to choose the most appropriate PUS, we proposed a formula that allows to classify the candidate sites by their evaluation on the basis of a quantification of their criteria, increased by their coefficients to better appreciate this one, to facilitate decision-making.

This work is part of an approach to implement a digital ecosystem that assumes several considerations including the judicious choice of geolocation of a local logistics unit, its role and its provisions, and secondly, the establishment of an intelligent information system to improve the efficiency of the humanitarian supply chain, combining several technologies: GIS, IoT, Cloud computing, Big Data and AI.

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