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Real-time Monitoring for a Humanitarian Logistic Network

The American IFRC Study Case

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ABSTRACT. *Humanitarian organizations like International Federation of Red Cross (IFRC) are moving from centralized or regionalized logistics networks to sub-regionalized logistics networks. Logistics capacities are settled up at country level to manage closer to the field contingency stocks and relief material flows. The objective is to still increase the responsiveness and effectiveness of disaster responses. But such an evolution implies challenges in matter of resource management or cost-control. The problem is that generally humanitarians are not really mature in terms of decision support systems and particularly, in terms of performance management. In this research work, we try to bridge this gap by developing a solution to monitor a sub-regionalized logistics' network. This solution is based on a real application case (IFRC America).*

KEYWORDS: *Monitoring System, Humanitarian Logistics, Sub-regional Logistic Network.*

1. Introduction and Background

During the last 15 years, humanitarian organizations have deeply changed their approach to supply chain management. Pushed by internal and external pressure, humanitarian organizations have prioritized the improvement of the logistics network design, as it provides the framing for all further operations.

The IFRC has developed a permanent network of regional logistics units (RLUs) strategically located in three hubs: Panama, Dubai and Kuala Lumpur, with a secretariat-based department in Geneva. To increase responsiveness and effectiveness, the American and Caribbean (A&C) RLU, based in Panama, is planning to transform the regionalized logistics networks to a more decentralized sub-regionalized network. In sub-regionalized networks, logistics capacities are set up at country-level to manage contingency stocks and relief material flows closer to the field with the aim to increase the effectiveness of disaster responses. This evolution implies challenges with respect to efficiency-related aims such as resource management or cost-control. Furthermore, sub-regionalized organizations may limit possible economies of scale, or the chances for risk pooling compared to more centralized solutions.

However, the potential of the sub-regionalization is to use the full network as pool of contingency stocks and human resource capabilities (Figure 1). Decision Makers ideally can choose to source items from the warehouse that can deliver fastest to the point of need, taking also into account the costs of transportation, and the available resources. This is an opportunity to improve efficiency and responsiveness. This approach, however, requires a real-time overview of the network, so there is a need to collect the information related to the inventory and the capabilities (skills) with a common monitoring tool.

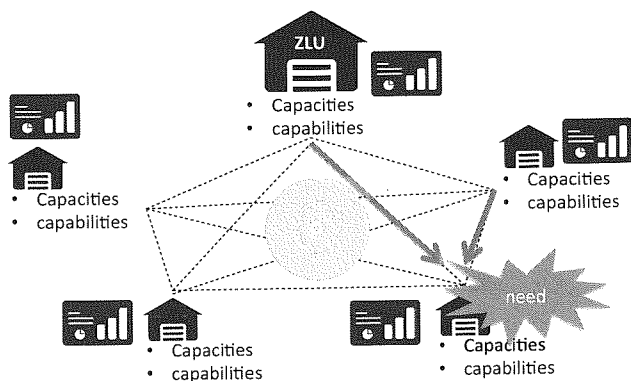


Figure 1. Sub-regional intelligent network

Actually, despite the potential of new information systems (IS), as outlined in the, 2013 Red Cross World Disaster Report (Vinck, 2013), some of today's technologies are still often unused or ineffective in humanitarian context. Although there is a plethora of tools available, a real gap exists between the technologies and models and their application in the field (Rongier *et al.*, 2010; Holguín-Veras *et al.*, 2013). The causes are often at least in part political or cultural and cannot be fixed by merely developing new technologies. One factor that prevents adoption is the difficulties to deploy the existing tools. In many cases, these tools can be used only by specialized technical experts and not by field-based practitioners, because of their low technological background and lack of training due to turnover. It is therefore imperative to develop an empirically grounded development approach that can cope with the complexity of a humanitarian environment, and take into account the real practices. Field research highlights that the knowledge that actors needs (i.e. logisticians and SC managers) are often located in various heterogeneous sources, which are only partially reliable (Van de Walle and Dugdale, 2012).

The paper summarizes insights from a design study conducted with the A&C RLU for their sub-regional logistics network. In the remainder of the paper, we firstly, describe the field oriented research and design methodology. Then, we present a work-in-progress application development that proposes a concrete, pragmatic and accessible monitoring solution dedicated to humanitarian logistics activities.

2. A Field-oriented Research and Design Methodology

The insights reflected in this paper are the result of a participatory research approach. After a pre-study and literature research on the topic, a field-research visit at the A&C IFRC RLU at Panama City was conducted to analyze and formalize the needs for a logistics monitoring tool. The research questions addressed were (i), understanding the IFRC logistics strategy, and (ii) identification of shortcomings in monitoring and decision support IS. The data collection methodology was inspired by the Disaster Resilience Lab field missions (Chan and Comes, 2014). We used semi-structured individual interviews with process and information mapping supports and observations. The interviews were targeted to the regional logistic profiles: logistic officer, warehouse manager and officer, procurement, finances and logistics development coordinator.

From this fieldwork, dedicated specifications have been identified for a system that enables humanitarian field practitioners to monitor their logistic network. The main objective is to address the gap existing between existing technology and the lack of field logistic monitoring applications. The prototype will be tested and evaluated at the IFRC A&C. It will provide the basis of future research, oriented to the operational research (OR) for the sub-regional network.

3. Monitoring the IFRC Sub-regional Logistic Network

Considering that the current IS and flows at the A&C IFRC do not provide a real-time overview of the sub-regional network, and that technological barrier is too important to deploy commercial solutions, we tackle the issue with the development of a simple and accessible dedicated IS that monitors the sub-regional network.

3.1. *The IFRC Sub-regional Logistic Network Design*

The sub-regional logistics network design consists of a regional hub prolonged by a network of capacities (inventory and infrastructures) and capabilities (logistics skills) at country level. The sub-regional contingency stocks are owned by the IFRC, but hosted by the Red Cross National Societies (independent entities, but members of the IFRC), who are in charge of the logistic management (warehousing, customs, transportation). In function of the capability enhancement, they could also be in charge of sourcing and procurement.

When starting our analysis in, 2015, the network had four sub-regional pre-stocks that are already deployed and a dozen more are planned to be ready in the coming months. Although the network is growing, the operation mode is centralized. The RLU, based at Panamá, manages all the warehouses procurement, and the sub-regional Logistic Units (SRLU) distributes only for internal country needs. As long as almost all the stocks are mobilized from (or through) the regional hub, and transport options are limited, decision-making at regional level is based on the reliable monitored information and the experience of the practitioners.

3.2. *Practitioners Needs Analysis*

The information flow, as designed today, is centred on the Regional Logistics Officer (RLO). RLO is the intermediary between all the logistics actors Warehouse Managers (Panama and SRLUs), the Procurement Officers and the logistics coordination at Genève as well as the customer: PADRU and the NSs. The RLO gathers information via e-mail or phone calls, updates the management Excel Sheets, detects gaps and overstocks, and distributes requests and information.

The practitioner's identified needs concerning monitoring, during the field-research are summarized in the following list:

- collect basic logistics data at the network scale;
- the RLO has to be able to check the network inventory level on real-time. SRLUs have to transmit information on real-time about any movement on real-time contingency stocks, and have to provide skills availability;
- eliminate redundant, inaccurate or irrelevant information;

- reduce the time of information transmission between automated devices and systems, stakeholders and decision-makers;
- automate simple analyses or actions based on predefined business-rules;
- prevent in case of misalignment with the strategy objective;
- increase the reliability and veracity of information;
- improve the agility and decision-support capabilities of the humanitarian stakeholders.

3.3. Requirements of the Prototype

The monitoring system has to rapidly manage information and knowledge about the logistics network resources to ensure that decision makers receive adequate and timely information to make operational decisions. Only the requested data has to be transmitted. With a central database, the traceability and accuracy of information is upgrade.

It has to be able to integrate data coming from different sources (information systems) and permit an easy overview of the network state. The system has to guarantee that update frequency is sufficient to enhance veracity.

The system has to detect and alert decisions when there is a misalignment with the strategic objectives of inventory level or capability.

The perimeter of the monitored logistics network concerns capabilities and capacities. Capabilities refer to the logistic skills availability at each SRLU, including warehouse management and operations, purchasing or sourcing. By capacities, we refer to the real-time inventory level, order and shipping preparations for each warehouse.

3.4. Monitoring System Description

The monitoring system we suggest is a database linked to an indicator dashboard with the network status. To be as accessible as possible, the prototype solution is a web-based platform. A server host runs a database and the application and shares their resources with clients. A client requests content or service functions from the server.

The technological choices to develop the application are:

- *MySQL*, an open-source client-server relational database management system;
- *Vaadin* (vaadin.com) for the interface development, an open source Web application framework based on *JAVA* programming language.

Vaadin was chosen because it has add-on libraries with specific interface functionalities that supports fast prototype developments for user-friendly business web applications.

We consider that users have different skills and technologic background, so the interface is designed to be intuitive and simple. Two levels of visualization have been defined: the network overview, and the country level view. Figure 2 shows the dashboard prototype for the network overview interface.

Logistics network state interface aims to support the RLO decision-making tasks. The view consists of three main elements:

- cartography of the concerned region: providing information about the alignment of resources regarding the sub-regional strategy;
- warning list: automatically generated with simple business rules. This will enable users to manage a warning ticket list, assign the ticket to a responsible person and manually update the state of the issue. Each warning ticket refers to a resource and to a specific country;
- Resources by category: a list of indicators for the network resources. We consider capabilities and capacities. Each resource has a three levels indicator (☺☹☹) showing the alignment of the resource regarding the strategic objective.

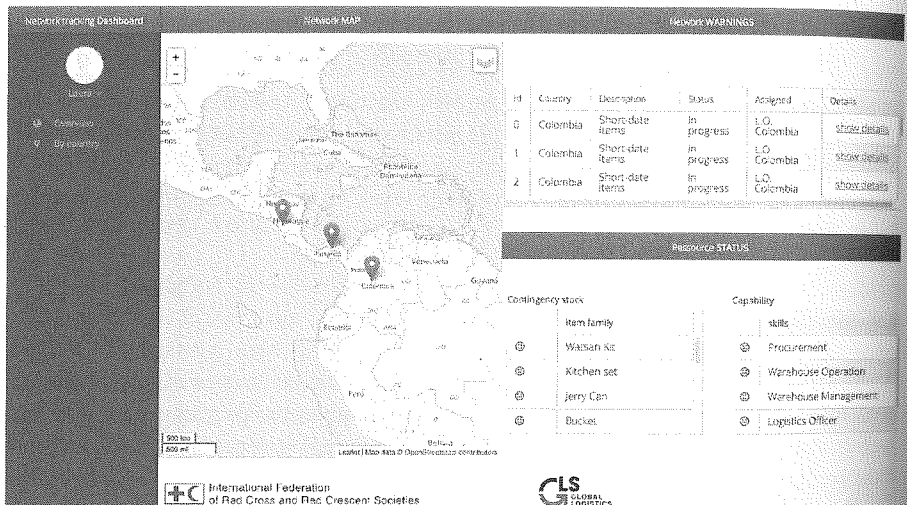


Figure 2. Monitoring Dashboard prototype

The indicators on the country level interface are similar to the previous one, but for a specific country (or LU). The cartography will show the emplacement of the local warehouses.

3.5. Data Collection

The system has to integrate data coming from the different Information Systems into a common platform. Data collection has to take into account the technology readiness of the warehouses is different in each NS. This data could be introduced manually or through an automated system (e.g. bar codes, RFID) as many commercial applications do.

The proposal for the prototype is to use two upload possibilities: a simple form to be filled on the online application or a file exported from the standard IFRC warehouse management tool. The data integrity will depend on the periodicity of update.

4. Conclusion and Future Work

The prototype we propose in this work-in-progress insight paper aims to enable real time monitoring as a first step to improve cost-efficiency and responsiveness of a sub-regional logistics network: This paper is a snapshot within a dynamic development process, and will evolve in further the exchanges with IFRC practitioners. We expect to have a first version to be tested at the IFRC during the first semester, 2016, followed by on-site testing, reconfiguration and validation.

A remaining challenge is monitoring country level logistics infrastructures (ports and airports) and the transportation between the SRLU and end users. The transportation times and costs are of fundamental importance to develop an optimization tool to plan cost-efficient and fast operation modes.

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