Towards a Monitoring System for American IFRC Logistics Network

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ABSTRACT

The International Federation of the Red Cross and Red Crescent (IFRC), is one of the many humanitarian organizations that are further developing their logistics network more decentralized structures with sub-regional networks. One of the main challenges identified is the need of monitoring tools to have a real-time overview of the whole logistics network state, and optimization of the associated operations through real-time decision support systems. Logistics departments of humanitarian organizations have not adopted the technological developments that are standard in the commercial sector due to critical differences, and the IFRC is not an exception. This paper presents a case study conducted with the American and Caribbean IFRC. We present user requirements and specifications for the design of a real-time monitoring system dedicated the sub-regional network. It particularly addresses the challenges to simplify remote data collection, visualization and analysis.

Keywords

Monitoring systems, humanitarian logistics, logistics network, IFRC.

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. Effective collaboration between stakeholders is a key

factor to achieve the efficiency of the system. The alignment of information flows, and coordination of monitoring and decision processes that are key to such collaboration, however, remains a challenge for humanitarian organizations.

However, the potential of the sub-regionalisation is to use the full network as pool of contingency stocks and human resource capabilities (Figure 1.b). 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 capabilities. 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.

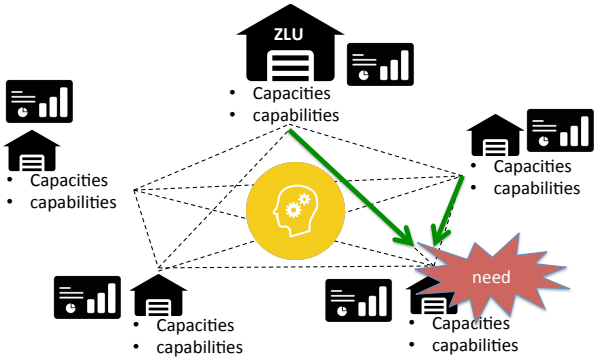

Figure 1 Sub-regional intelligent network

Actually, despite the potential of new information systems (IS), as outlined in the 2013 Red Cross World Disaster Report (Vinck et al. 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 introduce IFRC study case and the monitoring challenges we identified. Finally, we present a work-in-progress application that proposes a concrete, pragmatic and accessible monitoring solution dedicated to humanitarian logistics activities.

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 analyse 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 where targeted to the regional logistic profiles: logistic officer, warehouse manager and officer, procurement, finances and logistics development coordinator.

From this fieldwork, dedicated specifications and a prototype have been developed 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.

STUDY CASE: THE IFRC SUB-REGIONAL LOGISTICS NETWORK DESIGN

The A&C RLU is in charge to deliver humanitarian logistic services to the American zone, in collaboration with PADRU, the Panamanian Disaster Response Unit. On 2014, PADRU coordinated 16 relief operations, most of them for natural disasters affecting more than 225,000 people. The A&C RLU has an average turnover of CHF 15 millions per year with a contingency stock equivalent to 5,000 families needs coverage.

The set-up

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 prep-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 (Figure 1.a). 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 mobilised 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. With the current information management it will be difficult to enhance responsiveness and cost-efficiency due to the increase of the overall stock level (decentralization) and of the rigidity of operations.

The IFRC's monitoring approach

Today, the regional inventory, including the country level stock, is managed from the RLU at Panama with support of Excel data files and a dedicated Warehouse Management System (WMS). The inventory data (quantities, short date items) is reported monthly with reports extracted from the WMS and then integrated to an inventory management Excel data sheet. Considering that today there are 4 sub-regional warehouses, Logistics Officers may have enough information to deduce, based on their experience, the procurement, transport, and other logistics operations needs. However, when the sub-regional network will be deployed there will be a growing number of prepositioned stocks and an exponential growth in data. Moreover, SRLU may have different software to manage the stocks. To obtain an overview of the network it will be difficult with the current Excel support.

In addition, the workload for humanitarian logistics rises when a disaster occurs, and operational decisions (procurement, transportation, sourcing) have to be made in short time. To have a reliable overview of the network, the reporting cycle will have to be reconsidered.

This brings two main challenges to manage the logistics network efficiently:

a) Real-Time Monitoring: how to rapidly collect and manage information and knowledge about the logistics network (capacities and capabilities) to ensure that decision makers receive adequate and timely information to make operational decisions.

b) Decision Support System: given the complexity of the operations, experience alone will not suffice to enhance efficiency. There is a need of optimization-based decision support systems that suggests the adequate operation of the logistics network on real-time.

In this paper we address the first challenge. In the next sections, we discuss the IFRC's needs for real- logistics time monitoring, and we introduce a concrete solution to monitor a sub-regionalized logistics network.

MONITORING THE IFRC SUB-REGIONAL LOGISTICS 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.

Monitoring perimeter

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. The inventory (or stocks) can be of different ownership:

- The IFRC owned, also called contingency stock. The main warehouse is the one located in Panama (RLU), supported by the sub-regional warehouses stock managed by National Societies.
- Partner National Societies (PNS) owned. PNS organizations (e.g. British Red Cross, American Red Cross) use the RLU to stock their own inventory. This inventory is included in our perimeter if it can be used in case of disaster (with certain conditions and authorization) and the RLU staff manages it.

Practitioners needs analysis

The information flow, as designed today, is centered on the Regional Logistics Officer (RLO). She/he 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 logistics monitoring dashboards, detects gaps and overstocks, and distributes requests and information.

The identified needs 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 the contingency stocks, and have to provide skills availability.

- Eliminate redundant, inaccurate or irrelevant information.
  The monitoring system act as a filter, and only the requested data has to be transmitted.

- Reduce the time of information transmission between automated devices and systems, stakeholders and decision-makers
  The data is updated on a web-server, and the monitoring system has to be automatically updated.

- Automate simple analyses or actions based on predefined business-rules.
  And an alarm system has to prevent in case of misalignment with the strategy objective.

- Increase the reliability of information.
  With a central database, the traceability and accuracy of information is upgrade. The system has to guarantee that update frequency is sufficient to enhance veracity.

- Improve the agility and decision-support capabilities of the humanitarian stakeholders.

Technical Specifications of the Prototype

The monitoring system we develop consists of a knowledge database linked to a dashboard that shows key indicators of the network status. The architecture of the prototype application is a web-based model. 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.

Monitoring System Description

The main aim of the monitoring system is to meet the elicited needs: information collection and logistics network monitoring. We consider that users have different skills and technologic background, so the interface is designed to be intuitive and simple.

Two main levels of analyses have been defined: the network overview, and the country level view.

Main interface - Overview of the regional logistics network

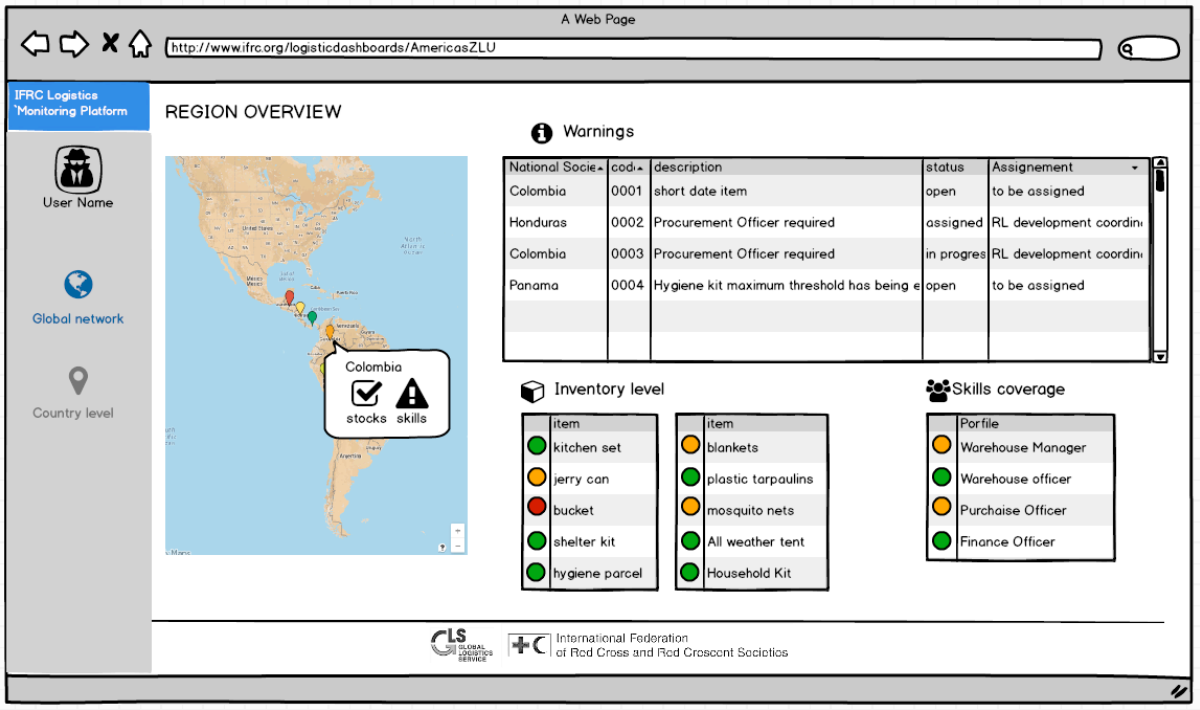

Figure 2 Main interface design

For the application interface (Figure 2 Main interface we suggest to have a main overall view of the logistics network state. This 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. This will be visualised with a binary indicator: aligned/not aligned
- Warning list. Warning messages will be automatically generated with simple business rules (see next section). 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 (like traffic lights) indicating the alignment of the resource regarding the strategic objective. This is a global network indicator.

Country level view

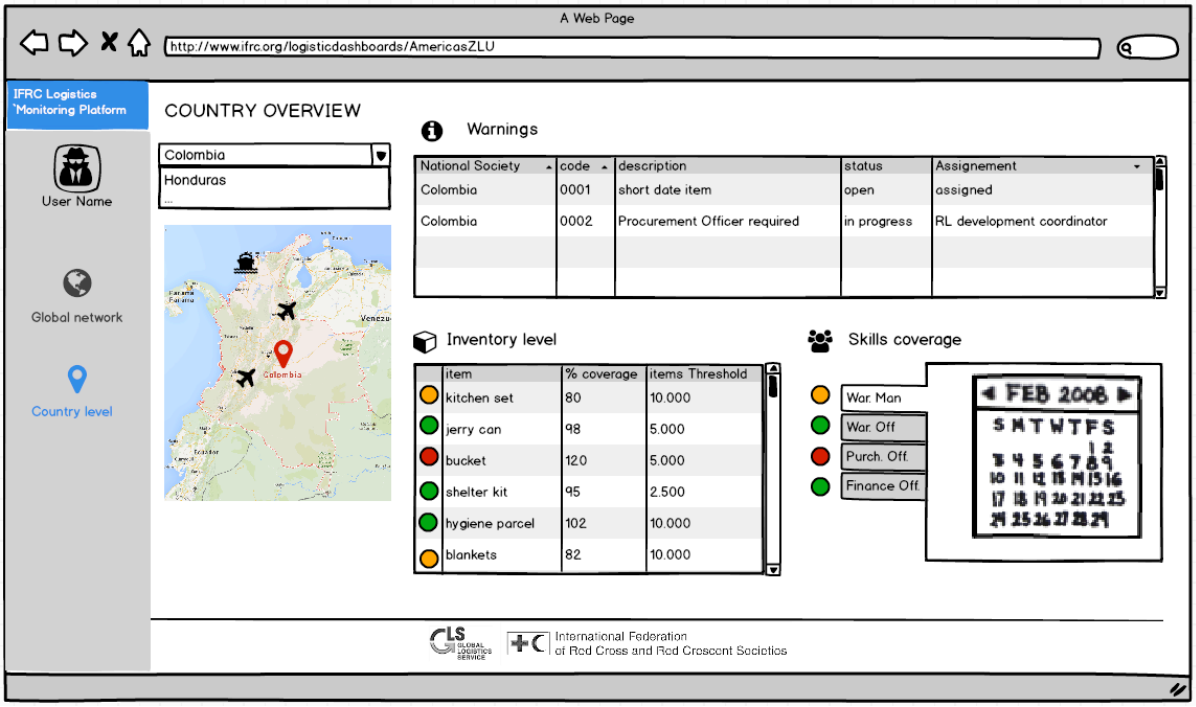

Figure 3 Country level interface design

To check de details of the resources for a specific country (or LU), the user can navigate to a country-dedicated view (Figure 3) by double clicking on the map pointer, or by changing on the left side menu to the country level view. The elements on this interface are similar to the main interface:

- Country cartography: provides the country level warehouse location.
- Warning list: contains the same information that the main interface warning list, but filtered for the concerned country.
- Resources by category. For capacities, it shows the country contingency stock level with the same colour indicators, and the absolute (item number) or relative value (% objective coverage). It shows also the strategic objective. For capabilities, the interface shows the availability of skills for next six months with a calendar view.

Business rules

Business rules (BR) can be defined as "*a statement that defines or constraints some aspects of the business. It is intended to assert business structure, or to control or influence the behavior of the business*" (BRG 2008). In our context the rules are based on data that is captured by the monitoring system. The BR are designed to ensure that the sub-regional logistics network state does not differ "too much" with the planned one, in this case the IFRC strategy. When the application detects a violation of a minimum or maximum stock level, it will generate a warning ticket. For human resources, the BR can determine if the profiles are covered. For instance, if an SRLU is required to have a purchase officer, a BR can check if the profile is affected to a physical person.

The IFRC strategy will define the threshold inventory quantity to have in a warehouse, the short-date item period, or the skills profiles required on a SRLU. Example BRs concerning the inventory are:

- If minimum inventory threshold > real inventory level then the warning system creates a ticket to launch a replenishment procedure
- If expiration date is close to date then the warning system creates a ticket to launch a short-data items procedure

Similar rules will be applied for the capabilities availability:

- If a skills profile is empty for a period of time then the warning system creates a ticket to launch a training

or employment procedure.

These rules are a basic support for decision makers, as they highlight automatically the deviation of the logistics network to the organization objective.

Data collection

The system has to integrate data coming from the different SRLUs 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 interoperability of the network will have to gather the different kind of data, and be able to integrate all of them on a single platform.

The proposal for the prototype is to use both a simple form for each stock movement, to be filled on the online application and to upload a file exported from the standard IFRC warehouse management tool.

There are to main categories of data to be collected: capacity and capability.

Data collection has to be as simple as possible, even if "to be purist" the inventory should be monitored as a flow:

$$\text{Available stock} = \text{InStock} - \text{Committed} + \text{ordered}$$

RLO needs to know what is available in the network warehouse at any time. To simplify data collection and management, data for each warehouse will be updated from each SRLU with a periodicity and when there is an inventory movement.

For the capability update, the user will have to fill a form to match a concrete profile (skills) with a person, and an availability timetable for a certain period of time. This will allow the user to have an overview of the current and future availability to anticipate potentially missing resources.

OUTLOOK 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.

The prototype development is on first stage, and 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.

We have identified some potential developments to enhance a performing monitoring system, like the administration of the users rights, or the inclusion of resources owned by Red Cross and Red Crescent National Societies. Some NS within the A&C region have their own contingency stock, including powerful NS like Mexico. Today, this is not considered as part of the regional contingency stocks.

Another challenge is the monitoring of the country level logistics infrastructures (ports and airports) and the transportation between the SRLU and end users. For an optimization tool that deduces cost-efficient and fast operation modes, the transportation times and costs are of fundamental importance. We have to anticipate the collection of this data and introduce it to the monitoring tool on these first stages.

ACKNOWLEDGMENTS

We would like to sincerely thank all the IFRC GLS Panamá team for their collaboration in this project, and especially for their warm welcome during the Panama visit.

REFERENCES

1. Chan, J., Comes, T., 2014. Innovative Research Design – A Journey into the Information Typhoon. Procedia Eng., Humanitarian Technology: Science, Systems and Global Impact 2014, HumTech2014 78, 52–58.
2. Holguín-Veras, J., Pérez, N., Jaller, M., Van Wassenhove, L.N., Aros-Vera, F., 2013. On the

appropriate objective function for post-disaster humanitarian logistics models. J. Oper. Manag. 31,

3. Rongier, C., Gourc, D., Lauras, M., Galasso, F., 2010. Towards a Performance Measurement System to Control Disaster Response, in: Camarinha-Matos, L.M., Boucher, X., Afsarmanesh, H. (Eds.), Collaborative Networks for a Sustainable World, IFIP Advances in Information and Communication Technology. Springer Berlin Heidelberg, pp. 189–196.
4. Van de Walle, B., Dugdale, J., 2012. Information management and humanitarian relief coordination: findings from the Haiti earthquake response. Int. J. Bus. Contin. Risk Manag. 3, 278.
5. Vinck, P., International Federation of Red Cross and Red Crescent Societies, 2013. World disasters report 2013: focus on technology and the future of humanitarian intervention. IFRC, Geneva.