

A study on the sub-regionalization of Humanitarian Supply Chain: the IFRC case

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ABSTRACT

Humanitarian Supply Chain (HSC) performance is a key factor for disaster response. In order to be more responsive, the typical humanitarian supply strategy has evolved from a centralized to a decentralized network, generally at regional level. The objective was to reduce lead-times and costs. However, after a decade of working, organizations like the Americas and Caribbean International Federation of the Red Cross and Red Crescent (IFRC) have noticed that those objectives are only partially reached and have decided to go further in the evolution by developing sub-regionalized networks. In this study, we analyse the HSC sub-regionalization process to better understand the challenges and opportunities for humanitarian organizations. Three key aspects are point out: implementation, real-time monitoring and operations' cost-efficiency. Based on these results and considering the law maturity level of humanitarian organizations in terms of Information and Decision-Support Systems, we conclude with giving concrete guidelines for designing and developing ad-hoc monitoring and orchestrating systems.

Keywords

Humanitarian Supply Chain, sub-regional network, Decision-Support Systems, preparedness, logistics network.

INTRODUCTION AND PROBLEM STATEMENT

Context

The response to sudden-onset disasters has revealed organizational, behavioural and technological shortcomings. For instance, the contingency stock management of humanitarian organizations shows a significant misalignment with actual needs, producing excessive stock coverage and important bullwhip effects all along the Supply Chain. For instance, the 2010 Haiti disaster has still remaining huge consequences on the inventory level of Americas and Caribbean IFRC: 4,884 remaining hygiene kits are going to expire by the end of 2015. Moreover, the competition for funding, which is insufficient to cover all the humanitarian activities, is

today a reality (*Global Humanitarian Overview*, 2015). Under such pressure, the design and management of Humanitarian Supply Chains (HSC) needs to be adjusted or reconsidered.

For a long time, humanitarian organizations have understood that getting the right resources, at the right place and at the good time is crucial for a successful intervention. They consequently focussed on logistics operations. The usual configuration used to be a central Head Quarter (HQ) based in a developed country that manages relief supply and operations far away from the field. Experience showed that this can lead to inefficient operations (w.r.t. time and cost) (Jahre, 2008). A decade ago, most of the global humanitarian organizations started decentralizing the management of their response by setting up regional logistics units (RLUs) for emergency stock prepositioning.

In this new configuration, a HSC can be divided in two main parts. The RLUs, organised as linear supply chain networks, constitute the upstream part of the HSC (Figure 1, upstream on the left side). They are permanent units and have a role throughout the disaster cycle, i.e., in a HSC context preparedness; immediate response; support and dismantling (Charles et al., 2009). RLUs include the operational activities from the sourcing of material resources, warehouse management, to the distribution of items to a relief hub. The downstream part (right side in Figure 1) refers to the ephemeral supply structure created in the aftermath of a disaster.

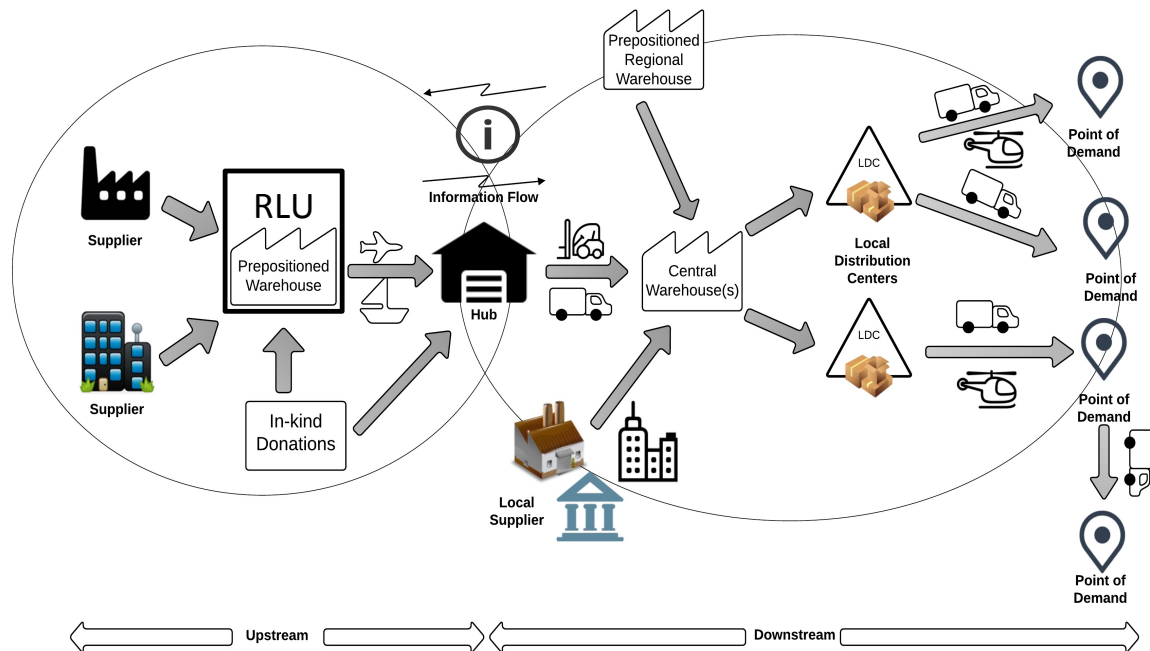


Figure 1 A typical HSC structure in distribution plan

Advantages of this new organization were recognised by both international academics and practitioners. Jahre (2008) and Gatignon et al. (2010) for instance have demonstrated them. But they also highlighted the difficulties to implement such an approach in the humanitarian context.

Considering the results of the decentralisation recorded during the last decade, humanitarian organizations are trying to further improve the responsiveness of RLU by deploying country level Logistic Units. This process, called sub-regionalization, consists in bringing the contingency stocks still closer to the (potential) beneficiaries.

Problem Statement

Considering that the IFRC's Americas and Caribbean RLU (A&C RLU) is starting a sub-regionalization process, we aim to (1) understand their motivations and aims in the general context of HSC design (2) identify the main challenges they have to cope with and (3) identify directions for research that should be developed to support an efficient sub-regional HSC.

The considered IFRC sub-regionalisation strategy is quite similar to other humanitarian organizations that are evolving in the same space, such as the UN agencies, with the UN Humanitarian Response Depots (UNHRD) managed by the World Food Program (WFP). Different typologies of global organizations could also require applying similar solutions in the near future, like the medical NGO *Médécins Sans Frontières*.

In this paper, we firstly highlight the benefits and limitations of the previous HSC regionalization and set out to explain the rationale of the evolution towards sub-regionalization. This is developed through an IFRC focus. Secondly, we develop the challenges that IFRC has to cope with to achieve such sub-regionalization with high efficiency. Thirdly, we propose research perspectives to address those challenges.

Methodology

The IFRC A&C RLU sub-regionalisation strategy was still vague when this study began in 2015. The initial goal was to support the IFRC A&C RLU to become more cost-effective by developing innovative HSC approaches. In compliance with (Eisenhardt, 1989), we decided to create research propositions based on empirical evidence. This consisted in studying the IFRC A&C RLU case to identify weaknesses of the current activity model in terms of business processes, decision-making and information systems.

In practice, after conducting preliminary interviews with the Regional Logistics Development Coordinator (RLDC), we designed guidelines, observations and mapping supports for semi-structured interviews and focus groups, inspired by previous field-research by the Disaster Resilience Lab (Comes et al., 2015). The fieldwork was conducted during a 10 days mission on October 2015 at the IFRC A&C RLU Panama site (office and warehouse). We interviewed all members of the RLU structure: Head, Service Officer, Procurement Officers, Logistic Officers and Warehouse Manager and Officers as well as the Panama Disaster Response Unit (PADRU) Coordinator.

The interviews and observations highlighted that the strategy is currently evolving. We identified the sub-regionalisation challenges and practitioners' needs. In addition to the field research, we did a literature review on the regionalization of HSC to better understand the whys and wherefores of this evolution.

HISTORY AND BACKGROUND

In this section, we review the HSC evolution on the last 15 years, with a special focus on IFRC.

Centralized Humanitarian Supply Chains

At the end of twentieth century, a typical HSC used to be made up of a number of loosely coordinated stocks of relief items owned by different humanitarian actors (UN agencies, the Red Cross and Red Crescent National Societies, NGOs...). The HSC structure reflected the overall disaster management that was centralised at HQ level. Typically, staff at HQ collected the information on humanitarian needs from the field for their advocacy and programming decisions. The main logistics flow was the materials from suppliers to the beneficiaries through country coordinators (Figure 2, IFRC example).

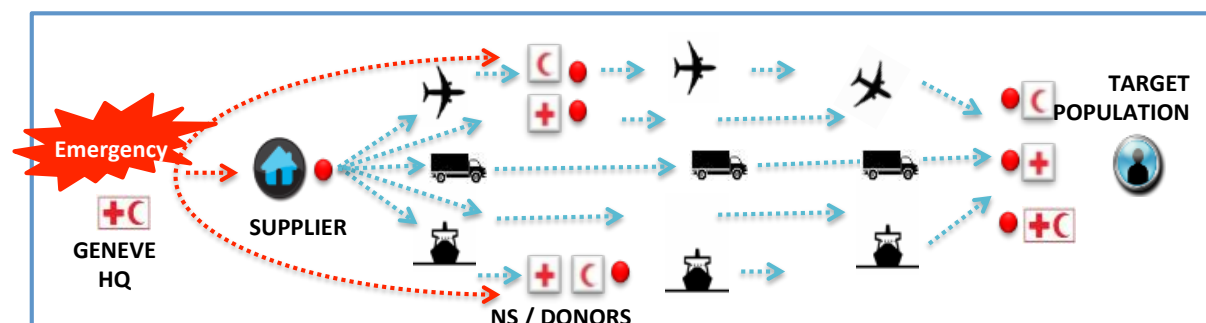


Figure 2 IFRC Logistics' organization up to 2006 (Grenade, 2015)

The increasing number of humanitarian disasters and the lack of efficiency generated external pressure on the humanitarian organizations. The catastrophic relief response to the Hurricane Mitch (Central America 1998)

with unacceptable response times lead to a public debate (Gatignon et al., 2010). Even if the international community mobilized great resources, the adequacy of interventions was questioned with implications for access to funding, and increased competition among humanitarian organisations. Humanitarian organizations needed to improve their accountability, also with respect to performance indicators such as cost and time. Moreover, for some organizations there was an internal pressure from the country coordination to decentralise and restructure the supply chain.

The internal and external pressures forced practitioners to focus on preparedness to improve response operations.

The typical strategy that resulted from this process was the creation of contingency stocks at regional level. This was the beginning of a transition from a centralized to a regionalized strategy with logistics as a core element.

Prepositioned stocks at regional level

This regionalized strategy has been implemented by some humanitarian organizations. It consists of the selection of strategic locations (RLUs) in different areas of the world that accomplish criteria such as presence of the organization or the access to potentially affected areas (Gatignon et al., 2010). This regional contingency stock of typical relief items can be pushed to beneficiaries in the aftermath of the disaster within 24-48 hours. This strategy provides logisticians some buffer time to pull the necessary relief items corresponding to the actual humanitarian needs that will take about two weeks to be in the field.

The IFRC, similar to some humanitarian UN agencies, is today following this supply strategy. In 2006, the IFRC inaugurated a permanent network of three RLUs strategically located in Panama “America & Caribbean”, Dubai “Africa, Europe and Middle East” and Kuala Lumpur “Asia”, with a secretariat-based department in Geneva. The RLUs were tasked with delivering mobilization, procurement, inventory management, warehousing and fleet services within their own region. They became intermediaries between the field, suppliers, Red Cross and Red Crescent National Societies (NSs) and HQs.

The regionalisation of the HSC (Figure 3) brought a quantifiable improvement in the disaster response: from reducing delivery time and costs to increasing effectiveness and efficiency (2011 GLS Annual Report, 2012). The scientific community evaluated the response to the Yogyakarta earthquake with this new organization (2006, Indonesia). Gatignon et al. (2010) emphasise that the operations of the IFRC were faster, better and cheaper thanks to the following key improvements:

- Standardized items and processes
- Traceability through adapted information systems
- Staff skills

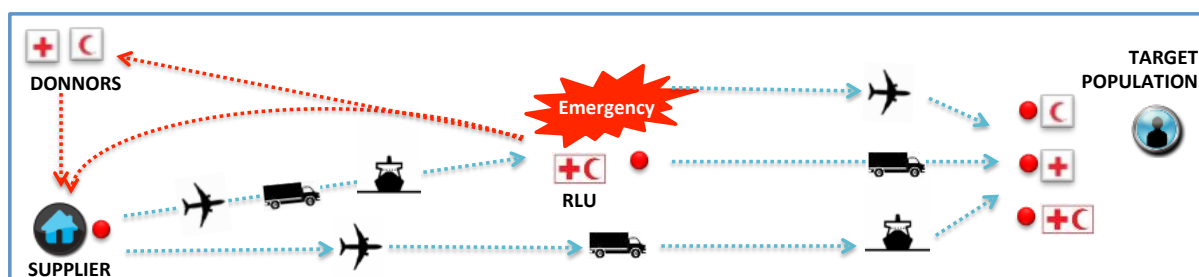


Figure 3 Regional Supply Chain (Grenade, 2015)

With the regionalization, the IFRC and the UN created humanitarian logistics service providers (3PL for humanitarians). The IFRC logistics regional network becomes the Global Logistic Services (GLS). Today, GLS and UNHRD offers are quite similar. They provide services to all the humanitarian community to generate enough revenues to cover the fixed costs that are necessary to maintain the supply capacities and capabilities.

Limits of the regional HSC design

However, after almost a decade, there are structural weaknesses that are pushing the decentralization further.

Poor adequacy for small and recurrent disasters

“66% of the disaster response is related to small or middle scale emergencies, most of them recurrent”

Silent disasters campaign (Barrena, 2015)



Figure 4 trends in funding requirements and people in need (source UN OCHA, 2014)

The last decade’s disaster statistic (Figure 4) shows a significant rise in the number and impact of disasters. This rise is significant at all scales, including also small and medium disasters. However, considering that only 10% of large disasters becomes news headlines (Barrena, 2015), and that 66% of disaster operations are for small and medium disasters, humanitarian organizations struggle to get funds because the lack of media coverage.

These so-called silent disasters are often recurrent, affecting the same region several times. In some areas, droughts occur regularly; with shorter or longer breaks in between. Other recurring disasters are hurricanes (e.g. Haiti was affected by 4 of them in the course of 2008 year) or floods (e.g. Pakistan was affected in 2010, 2011 and 2012) (Ferris et al., 2013).

The American continent is a good example of recurrent disasters. Looking at the Global Humanitarian Assistance Report 2015 (Swithern et al., 2015), any American country is in the top 10 of affected countries and international humanitarian assistance recipients (2004 to 2013). The crises affecting America are mostly natural disasters with recurrent patterns such as *El Niño* (Charvériat, 2000). These small-and-medium-scale crises constitute a very big percentage of emergency interventions by humanitarian organizations (Vargas Florez et al., 2015). Individually, each generates only a local impact, where there is no need to mobilise a massive amount of relief items.

In 2014, the IFRC A&C RLU launched 16 Disaster Response Emergency Fund (DREF), for small magnitude disaster and three appeals (large-scale disaster funding procedure) (Figure 5). If we extrapolate the trend of last 15 years, it seems that the number of small-medium response operations will tend to rise.

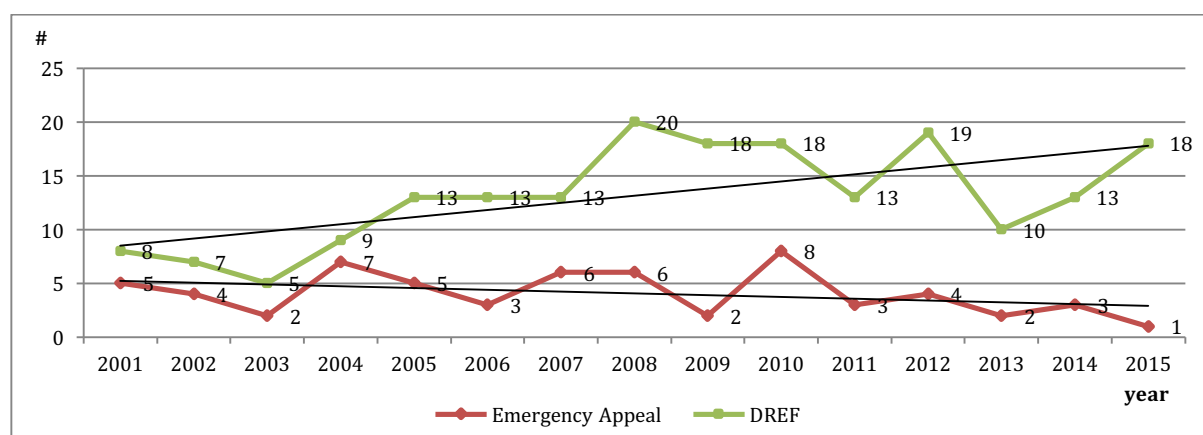


Figure 5 Emergency appeal and DREF 2001-2015 (source: IFRC PADRU, 2015)

This pattern has a big impact on the activity of the RLUs, which is sized for large-scale disaster responses. For example, each A&C RLU has a contingency stock to attend 50,000 families, but the activity in a standard year can be considered low (in America),

The economical sustainability of such logistic hubs is discussed in the next paragraph.

Lack of cost efficiency

The working costs of the IFRC RLUs are based since 2012 on full cost recovery (assets and infrastructures). This mechanism charges the costs of (i) supplying goods and services and (ii) covering overheads related to the logistic services management. In a standard year, response to crises does not generate enough rotation to cover the fixed cost of RLUs.

The IFRC GLS Annual Reports 2013 and 2014 highlighted this global problem from a finance point of view, presenting this deficit as a risk for the organization's sustainability.

This is also a problem for other similar organizations. On their side, the UNHRD RLUs are financed by the UN agencies and offer logistics services to other humanitarian organizations, which are charged with a management fee. To enhance their long-term sustainability, they are broadening their donor base (including the private sector) and increasing volume of activity by diversifying services.

The IFRC's strategy is similar, and consists mainly in providing logistics services like procurement, warehousing and distribution to third parties. For the IFRC, the main customers of those services are the Partner National Societies (PNS) and some international organisations like Oxfam. PNS are NS from developed countries that invest part of their funds on prepositioning relief items in addition to the GLS contingency stock. But even if this provides some extra revenue, it is not sufficient to ensure the economic long-term sustainability of RLUs like the IFRC A&C one.

Response time can be improved

Responsiveness is necessary to compete in the humanitarian domain. For a HSC, responsiveness can be measured by the time from a request reception to the last mile distribution. The IFRC announced that it aims at reducing the lead-time to 48h. Although with the regionalization, emergency items are closer to the field than they used to be, this aim is still out of reach. The lead-time IFRC announces is 44 days average on 2012 from a request is accepted to the distribution (Guatemala floods and earthquake operations) (Grenade, 2015).

By locating stocks closer to disaster-prone areas, transport time can be reduced. However, stocks can be at risk of being destroyed or inaccessible when a disaster occurs (Campbell and Jones, 2011).

Beyond risks to stocks, the supply trigger procedures and coordination between actors can also cause delays. For the IFRC, a RLU cannot start any procurement activity without a formal request from the field assessment team. And this can take from several days to some weeks. An IFRC Procurement Officer (Panama, September 2015) explains a case where the request took up to three weeks to be validated. There was a crisis in the West Indies

and the French Red Cross responded - instead of the IFRC - with their contingency stock placed at Guadeloupe island (not part of the IFRC contingency stock) because the RLU was attending for the request validation. Practitioners consider that those recurrent delays are mainly due to cultural distance (no country knowledge), as well as Jahre pointed out: “*even if RLUs are geographically closer to the regions often struck by disasters, they are still too far from the local communities with regards to culture, knowledge and geographical distance (...) they are stuck in the middle*”.

Local sourcing vs. international sourcing

Today, the procurement process of HSC is mainly based on a competitive bidding process. In addition, most of the humanitarian organizations have framework agreements with international suppliers to provide part of the standard contingency stock (e.g. blankets, jerry cans, kitchen sets, ...). For regular replenishment (non emergency) items are sourced internationally, mainly from Asia, due to the competitive cost. As consequence, the costs of IFRC standard items in the American zone reduced between 23% and 46% between 2009 and 2014 owing to this international procurement strategy (Grenade, 2015).

However, local sourcing stimulates local economy and reduces transportation costs. Moreover, local shipments require less documentation than international consignments that can stay blocked at customs for long periods. Despite these advantages, some items are difficult to be sourced at country level as long as the procedures to purchase are strict to maintain standards. And at regional level there is not knowledge and visibility of the local sourcing capacity (quality and availability) because they are too far geographically and also culturally.

Towards a sub-regional HSC design

In response to those limitations, humanitarian organizations are pushing for further decentralization. For instance, the WFP on behalf of the UN, has followed this trend to outreach the network to improve preparedness, by connecting UNHRDs to other existing prepositioned capacities (national depots, forward locations, or staging areas). The sub-regional approach aims to add or reinforce a logistics capacity layer closer to the beneficiaries, while maintaining the RLU and its advantages. This enables humanitarian organisations to:

- Size sub-regional contingency stocks adequately to the impact of recurrent disasters, and maintain a smaller regional contingency stock.
- Improve response time, thanks to shorter geographical distance. Moreover, involving (or empowering) the country level on preparedness contributes to improve the disaster response.
- Enhance local capability also may encourage local sourcing with a positive impact on sustainability (economy, society and environment).
- Re-design the HSC; it is an opportunity to improve the cost-efficiency of the system.

However, there is a risk for the prepositioned stocks and capabilities of being affected by the disaster, or to be overwhelmed by the demand (Heckmann et al., 2015). Moreover, the linear approach (stocks coming from the suppliers to the beneficiaries through regional and sub-regional hubs) continue to require high contingency stock.

AMERICAS AND CARIBBEAN IFRC RLU SUB-REGIONALISATION CASE

The A&C RLU revenues are strongly correlated to the number and importance of disasters affecting the American continent. The current operations do not economically justify the maintenance of such important logistics capacity: the RLU stocks inputs and outputs are low, as well as the volume treated per year. The typology of disasters, the responsiveness and the aim to enhance the NSs capacity favour a sub-regionalization. But this new strategy conflicts with the cost-efficiency challenge. To investigate this hypothesis, we analysed the IFRC A&C RLU as an example of sub-regional HSC design.

The sub-regional HSC design

The sub-regional HSC design consists of a regional hub connected to a network of capacities (inventory and infrastructures) and capabilities (logistic skills) at country level with the support of NS.

“Expansion of stock building at country level continued to be implemented in the Americas with IFRC stocks prepositioned in 4 National Societies by the end of 2014 and initiation of a plan to further expand to another 6-7 NS by the end of 2016”

GLS Annual Report 2014

Today, there are four operational prepositioned stocks at country level: Nicaragua, Honduras, Guatemala and Ecuador, and there are eight more expected for the end of 2016. These stocks are located inside NS warehouse on behalf of GLS contingency stock. The operation mode is linear: the regional hub manages all warehouses’ procurement, and each sub-regional warehouse distributes only for internal country needs (Figure 6). As long as the regional strategy has not been reviewed, the regional contingency stock coverage has been increased if we take into account the hub and sub-regional stocks, which was already overestimated.

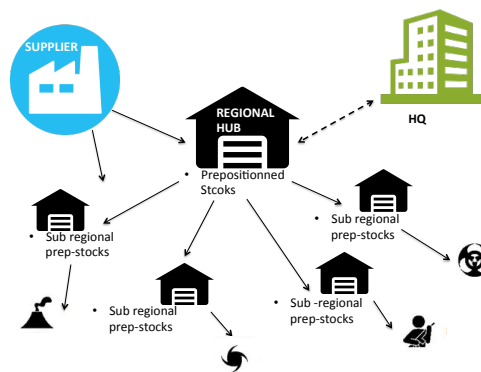


Figure 6 Linear sub-regional design

The strategy has proved its potential by reducing response time. Table 1 compares supply response time for different disasters typology affecting Guatemala during two periods. It illustrates the responsiveness improvements by being closer to the field with an extreme case. GLS Panamá does not calculate this indicator regularly.

	Year	Response time
Floods and Earthquake operation	2011/12	44 days average
Earthquake operation	2014	1-2 days average

Table 1. Guatemala Reduced response time (GLS Panamá, 2015)

However, to enhance a cost-efficient sub-regional HSC, there is room for improvement. Notably, the operations must be optimised at network level to ensure high service rate and low costs. This is what we discuss in the following.

Challenges to enhance a sub-regional Humanitarian cost-efficient network

Implementing capacities and capabilities

The first step to enhance a cost-efficient sub-regional system is to implement capacities and capabilities at country level.

The first challenge is to define a RLU strategy with respect to capacity, and to determine optimal stock levels for the sub-regional network. To improve in-country logistics capability, there is need for functioning infrastructures (warehouses, materials, vehicles, ...) as well as people with dedicated logistics skills. The warehouse deployment is based on an agreement with GLS, the concerned NS, and funding organization (IFRC or a Partner NS). GLS wants to involve NSs as “subcontractors”, and this is a huge obstacle.

NSs have very different maturity levels concerning logistics. To cope with this situation, GLS is in charge to develop logistics capacities through the National Societies Logistics Capacity Enhancement (NSLCE).

One main issue with this is the high turnover of the local volunteers and as a consequence the volatility of the NS priorities. Moreover, NSLCE is financed by Partner NS (like Norway or Canada), and it is difficult to sustain the enhancement in the long term, when funding runs out.

Managing the capacities and capabilities

Once the capacities and capabilities are deployed, the next challenge is how to manage and ensure the real-time state of the network. This is a prerequisite for any decision or action on the network.

However, as observed during our research visit to GLS A&C in 2015, the current HSC Management Support Systems have several limitations to support properly this approach. Practitioners will struggle to manage properly the inventories and replenishments (no visibility, no warnings, no decision support) and consequently increase the fixed costs.

Today, the support used to monitor capacities and follow the inventory levels is the HumLog software for warehouse management. The monitoring is centralized at the Panama hub, as it still was the only warehouse. The Panama warehouse manager gathers the region inventory movements, and sends each month a report (Excel Sheet) to the Regional Senior Logistic Officer (SLO) who integrates the inventory level to another Excel Sheet. Then, the SLO has to verify manually the inventory levels exceed pre-defined thresholds. Tomorrow, there will be at least eight more capacities (stocks in warehouses) to be monitored on and there will also be the capabilities to manage.

Making decision and orchestrating relief operations

To make cost-efficient use of the sub-regional network, practitioners should be able to coordinate several stakeholders during an operation (Figure). For instance, if there is a need in the region, which warehouse will have to send what and when? Who will manage the replenishments? Today, decision-making is only based on the Procurement Officer's experience and is fully centralised.

When the network will be deployed the possible options will be by a combination of variables that need to be taken into account, e.g., cost (items, transport) or lead-time. Thus, experience will not be enough to establish the best response to execute and decision support systems (DSS) will be needed (Miller, 1956).

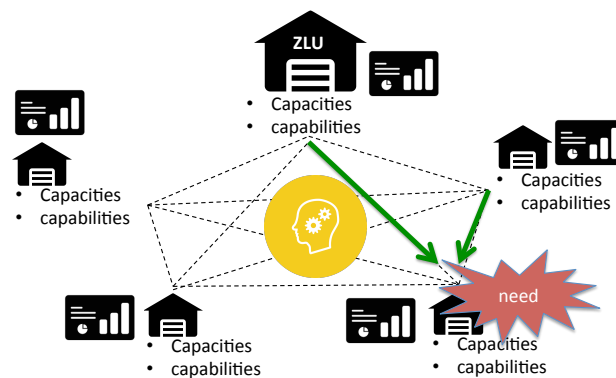


Figure Sub-regional coordinated response

Based on previous elements, it is possible to identify two key issues to address regarding decision making and orchestration:

- How to coordinate efficiently and efficacy the capabilities of a given region (hub and sub-regional warehouses)?
- How to use efficiently and efficacy the capacities of a given region?

HOW TO CONSOLIDATE THE SUB-REGIONAL APPROACH?

Three key challenges have been identified from this research work to succeed with a sub-regionalisation project: implementation, managing resources and operations decision-making.

Implementing capacities and capabilities

There are many publications on HSC literature concerning the warehouse network design optimization, or the traditional warehouse location problems (Vargas Florez et al., 2015) (Baharmand et al., 2015). Even if the results of such an optimisation provide insights to define an inventory management strategy, or the sub-regional warehouse locations, they do not take into account the organizational and political dimensions of HSC decisions. The IFRC A&C sub-regional development, for instance, is decided in concordance with worldwide organizational strategy and on funding opportunities so it is not based on a network location optimization.

To make the NS capacity enhancement sustainable in the long term, the Panama RLU needs to convince the Partner NS as well as to the IFRC hierarchy about the positive impact of NSLCE for them and for the global HSC. This will help avoid that NCLCE results disappear when the development programme finishes. This is a communication challenge that we envision to be addressed by developing suitable supports to have an overall view of the “humanitarian logistics capacity readiness”, and the evolution of these indicators with a link to the impact on the response.

Monitoring network capacity and capability

Literature indicates that Information Systems can contribute to HSC performance enhancement. Although much research has been conducted on this subject, just a few have a real impact on the field (Laguna Salvadó et al., 2015). The main difficulty is still to develop a system adapted to the humanitarian’s needs and uses.

Regarding sub-regionalization issue, we have shown that the visibility of the network has to be developed. The gathering and analysing of data must be done automatically through a dedicated monitoring system. This can be a knowledge database linked with a specific dashboard. The system has to integrate the data coming from the different warehouses into a common platform (Figure 7). Depending on experience and skills of humanitarians on these subjects, the data can be introduced manually on the database, or through an automated system (e.g. bar code, RFID, legacy system...), as many commercial systems already do.

Data collection has to take into account the technology readiness of the warehouses, which may be different in each NS. The interoperability of the monitoring system will be consequently an important issue. Future systems will have to manage different kind of data.

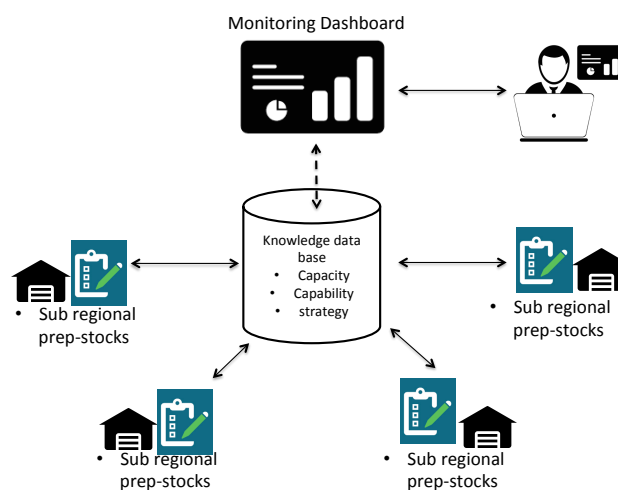


Figure 7 Monitoring System schema

Operation of the sub-regional network

The previous sections have discussed a possible way to design and control a sub-regionalized network. To enhance efficient and efficacy operations, challenges will do to the difficulty to perform an agile coordination of the resources. Consequently, following research works should study the question of the coordination and optimisation of sub-regionalized network. According to (Benaben et al., 2015) this question of coordination is broken down into three main components: (i) a coordination schema needs to be defined, (ii) the schema needs to be orchestrated and (iii) the executed coordination needs to be maintained.

To solve (at least partially) this issue, some authors suggest the development of Mediation Information Systems (MIS) dedicated to crisis or disaster management (Macé-Ramete et al., 2012). Such a solution provides and ensures (i) a link between all the network stakeholders (country level and regional level) activities and (ii) execution of a coordination processes.

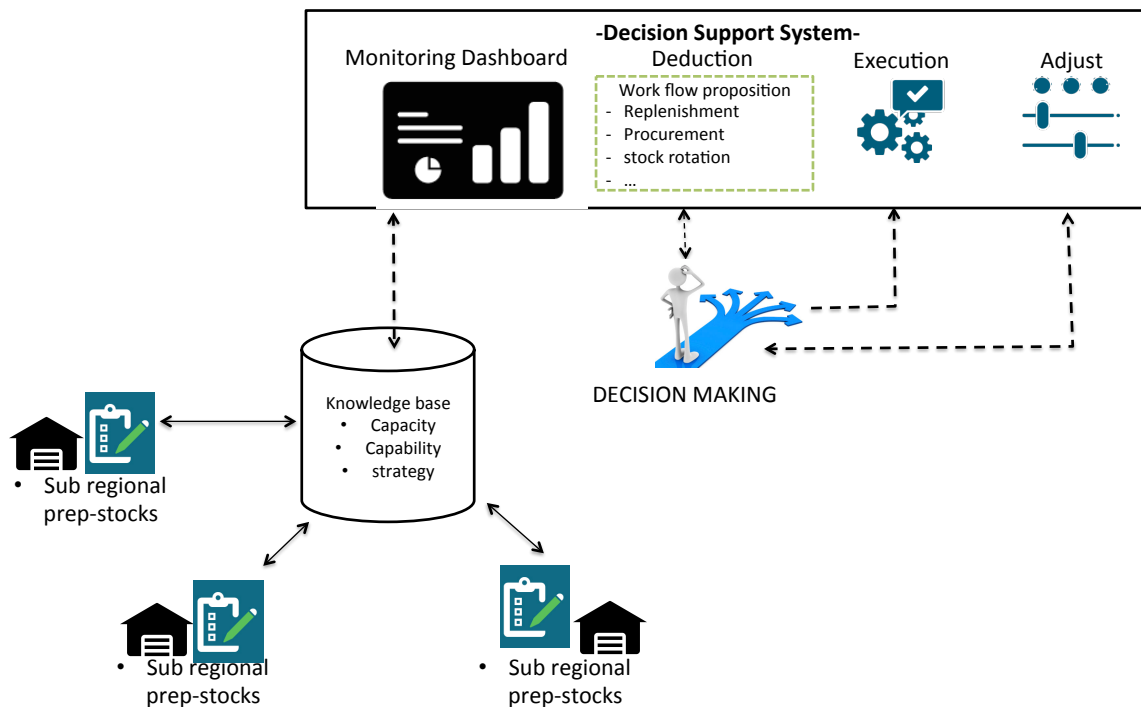


Figure 8 Components to be developed

In summary, Figure 8 shows a schema of the overall system that address the sub-regional network challenges previously identified, with four main contributions:

- A *monitoring dashboard* to detect potential disruptions and maintain the visibility on the network capacities and capabilities,
- A *deduction system* to suggest the best response (who should do what, when and where) of the whole network function of the needs and the network status,
- An *orchestration system* to distribute the things to between the actors in coherence with the response defined,
- An *agility system* to adapt properly the response to disruptions and hazards.

CONCLUSION AND PERSPECTIVES

During the last decade HSC have evolved from centralized to regionalized ones. Benefits of this new logistics network have been demonstrated in literature. But literature and field research also reveals some weaknesses

such as the misalignment between the regional approach and the small and medium disaster responses, the poor economical sustainability, the too high response times, and the poor local sourcing.

These weaknesses explain why some humanitarian organizations have decided to decentralize further towards a sub-regionalized logistics network with the location of contingency stock at country level. In the research presented in this paper we have analysed the IFRC A&C RLU case. The objective consists in pushing the contingency stock closer to the beneficiaries, while maintaining a regional strategy and management of the operations.

To enhance the cost-efficiency of a sub-regional approach, three main challenges have been identified and discussed: (1) implementing the logistics capacities and capabilities at country level, (2) monitoring in real time the network status and (3) operating the regional network in a coordinated manner. Considering that the current humanitarian decisions and information systems are not adequate to manage such a sub-regionalized network, we have suggested research orientations able to solve these issues. Practically our proposal consists in developing a dedicated decision support system able to manage sub-regionalized network capacities and capabilities as a whole. Such a system should include the following components: (i) a monitoring dashboard, (ii) a deduction system, (iii) an orchestration system and (iv) an agility system. Each one of these components represents concrete research perspectives that academics would study in the near future to support efficiently the humanitarian step of sub-regionalization.

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