“Optimization-based Evaluation of USAID/OFDA’s Global Logistics Capacity”

Summary Report of Phase I

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Introduction

The United States Agency for International Development's (USAID's) Office of Foreign Disasters Assistance (OFDA) collaborates with the Massachusetts Institute of Technology's Humanitarian Supply Chain Lab (HUSCL) at the Center for Transportation and Logistics (CTL) in the project "Optimization-based Evaluation of USAID/OFDA's Global Logistics Capacity". This collaboration intends to provide data-driven, model-based recommendations to optimize OFDA's global response capabilities.

The project runs from May 2019 until September 2020 and comprises to phases. In Phase I the project team conducted preliminary analyses to develop a deeper understanding of OFDA's operations and collected necessary information to conduct the modelling. Also, they used a preliminary model to showcase outputs and recommendations of a more tailored modeling approach, which is the main focus of Phase II.

This summary report highlights important findings and outlines a path forward for Phase II.

Preliminary analyses and findings

The project team collected information on OFDA's operations from different internal and external sources to understand OFDA's operations, to build a database of inputs for the model, and to determine further information needs. This is not a trivial exercise because OFDA's data collection efforts have only started to be rigorous in the last decade, i.e. they cover about 50 disaster responses and despite these efforts, the data is still fragmented and incomplete. Nevertheless, the project team used the available information to develop insightful analyses. The accompanying presentation to this report presents the analyses and findings in detail. In the following paragraphs we collect highlights that are particular important in shaping the path forward in Phase II.

Disasters

OFDA responded to approximately 115 disasters since 2000. Of these disasters, 65% were categorized as natural disasters and 35% are complex emergencies. The disasters mix varies depending on the region. In addition, the inter-arrival rates of disasters vary and about 86% (90%) of disasters follow each other within 0 to 120 (180) days. The typical re-supply lead time of OFDA's vendors is 120 to 180 days indicating that OFDA needs to respond to multiple disasters of unknown type, time, and size with a given inventory level.

The analysis indicates that the two disaster categories and, more importantly, different disaster locations have different commodity demands. This suggests that warehouses may need to stock inventory of different commodities to serve local demand patterns.

Our analysis also suggests that OFDA changed its activities over time. For example, from 2000-2010 there are more responses in East and South East Asia with more natural disaster responses. Lately, OFDA is more active in East and Central Africa and the Middle East with a focus on complex emergencies. If a change in the mandate of OFDA's response is indicated, a change in OFDA's operational network should follow.

Inventory Network

Currently, OFDA operates four warehouses: Miami (USA), Pisa (Italy), Dubai (UAE), and Subang (Malaysia). The locations are chosen mainly because OFDA has access to low storage costs (Pisa) or to reduce distance to recurring disaster locations to reduce distance for expensive airfreight (Miami, Dubai, and Subang).

Our analyses, however, suggest that all warehouses serve all regions. Some warehouses show a regional preference, such as Miami for Latin America and the Caribbean, but there is no warehouse catering exclusively to regions in its immediate proximity. The warehouses hold a mix of the six commodities (blankets, buckets, hygiene kits, kitchen sets, plastic sheeting, water containers) and because they serve a global footprint there are no indications for the inventory being tailored to the regions close by.

Transportation

OFDA mainly uses airfreight transportation. The shipment volumes indicate that for a substantial portion of shipments OFDA charters freight airplanes. For some smaller shipments, OFDA procures scheduled (belly) service. However, in most instances it takes too long to find sufficient capacity to use the scheduled-service option more often. In addition, OFDA has used sea freight for some smaller shipments.

The shipment data does not lent itself easily to an empirically reliable analysis of available carrier capacity and pricing. Anecdotally, the data suggests that airfreight originating in Miami might be more expensive than from Pisa or Dubai. The analysis highlights a need for better information, in particular, on freight rates, for model recommendations to be reliable. Alternatively, different transportation scenarios should be evaluated to ensure that any recommendation is robust against assumptions in the transportation portfolio.

Outlook and expected results of Phase II

The preliminary analyses indicate that USAID/OFDA has two core questions to solve. On the one hand, they have to identify how much inventory they should carry in their entire network. This is not a trivial question because OFDA does not know, when the next disasters requires assistance and how many people will be affected. In addition, OFDA's inventory levels need to be sufficient to serve multiple disasters because resupply lead times are longer than typical inter-arrival times of disasters. Clearly, higher inventory levels reduce the chance of not serving a disaster. However, OFDA has to trade off the ability to respond to disasters with the requirements for working capital, storage costs, and space.

On the other hand, OFDA should re-evaluate its warehouse footprint. Currently, OFDA runs four warehouses across the world intending to reduce expensive airfreight transportation cost. Since our analysis suggests substantial shipments outside the closest regions for each warehouse, the project team seeks to evaluate if the current network is optimal. For example, USAID/OFDA should explore using less expensive modes of transportation. A way to include more cost-efficient modes of transportation into a disaster response network – such as trucks or sea freight – is to establish local warehouses, for example, in Panama or in Central Africa. The question of OFDA's warehouse footprint is inextricably linked to the inventory allocation decision, that is, where should OFDA hold how much inventory. As such, a more tailored model can also provide insight into the optimal inventory allocation for given network options.

HUSCL has previously developed an insurance-driven modeling approach for other response agencies. The approach relies on the idea that a response agency maintains assets (such as inventory, warehouse space, modal mix) to insure against a disaster portfolio of unknown timing, location, size, and mix of disasters. In order to provide answers to questions raised before the project team will develop a model more tailored to the operations of USAID/OFDA. In particular, this model will capture the fact that resupply lead times take longer than the inter-arrival times of different disasters. This is a key difference in OFDA's emergency response operations compared to other humanitarian organizations. In addition, the model should allow for different modes of transportation and should trade off the costs and response times. The model should supply recommendations on (i) how much inventory OFDA should hold optimally balancing working capital requirements against stock out risk, and (ii) where in the current or an alternative network of warehouses the inventory should be located optimally balancing the storage and transportation costs against response-time requirements. To support strategic decision-making the project team seeks to develop metrics that characterize OFDA's responsiveness against a portfolio or disasters and allows comparing strategic options without little operational detail.

In addition, to the model advancements the Phase-I analyses indicate that better information on transportation capacity and rates for different modes of transportation need to be acquired. The project team intends to inspire collaboration with other response agencies (e.g. UNICEF, UNHRD, ICFR), the private sector (e.g. air link), or other proprietary (e.g. and RFI) or public information to create more reliable data inputs. If such data is not available, the project team will run different scenarios to ensure its recommendations are robust against different transportation settings.