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Research Report: ZLC-2013-7
Improving Inventory Management in Non-Emergency Humanitarian Aid Operations
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Improving Inventory Management in Non-Emergency Humanitarian Aid Operations

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Summary: This thesis examines the relationship between improving data collection and accurately setting an inventory control policy within a humanitarian aid organization. Interviews and analytical modeling are used to evaluate how one aid organization can more cost-effectively ensure a high service level of essential aid items.

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KEY INSIGHTS

1. Improved inventory control can increase access to medical supplies, bring down the costs, and ensure those supplies are available when needed.
2. Standard methodologies for inventory control as well clear channels of communication can improve data collection to inform inventory replenishment decisions.
3. Aggregating replenishment of diverse products with a single supplier while maintaining local suppliers can provide cost savings while still allowing for flexibility in responding to demanding variability.

INTRODUCTION

The World Health Organization (WHO) estimates that 30-50% of the population in Sub-Saharan Africa lacks reliable access to essential health products [1]. Consistent provision of health products and related support materials (e.g., clinic equipment like generators), combined with appropriate services, could massively reduce the impact of disease in Sub-Saharan Africa [2].

MedOrg, a humanitarian organization that provides medical assistance to vulnerable populations, aims to mitigate the factors that impair consistent access to the health services and products. It runs its humanitarian operations through multiple Mission Centers (MCs) based throughout Europe. Within each MC, there is a Logistics Department that supports logistics and supply operations of country-level projects. The head offices in each country (the "missions") are responsible for coordinating the medical and logistical needs of the projects around the country. All of the missions are served by one of three MedOrg supply centers, including MedOrg-Logistics, which serves Ethiopia, the mission that is the focus of this paper.

This thesis evaluates how country-level supply and logistics staff in MedOrg can manage stock keeping and product re-ordering to better match supply with demand during times of non-emergency conditions. Specifically, it evaluates (1) communication barriers that contribute to inefficient ordering processes, and (2) potential inventory control models that could provide a simple, easy-to-use method for ordering products. The objective is to support MedOrg in affordably ensuring access to core products in its field operations.

To do this, both qualitative and quantitative methods were used. Stakeholder interviews and a review of MedOrg's primary documents were conducted to evaluate possible areas of improvement in MedOrg's supply chain policies, procedures, and strategy. Analytic modeling of variations on the economic order quantity (EOQ), joint-replenishment (JRP), and order-up-to models was used to compare different approaches to improving MedOrg's inventory replenishment system. Input data for the model was derived from an analysis of MedOrg's procurement and logistics system. A literature review was conducted to gain comparative references for inventory control practices and replenishment models.

QUALITATIVE ANALYSIS – PROCESSES AND PEOPLE

Interviews

The interviews with the 11 MedOrg stakeholders, which included both logisticians and non-logisticians, revealed several obstacles to improving communication to achieve more consistent supply of products; these obstacles center around strategy, policy, and practice.

- At both the international and local level, supply chain does not have a strategic place in the decision-making process;
- There is lacking a formal system of communication or reporting between different departments and levels within MedOrg. While there is an online procurement and logistics system, it is used inconsistently, leading to distrust of system reports;
- Rather than following a formal reordering policy, current orders are based on the order quantities of previous order requests, adjusted for stock on hand, lead time (if the source had changed), and remaining budget.

Recommendations

Based on the literature review and interview results, several recommendations were made:

- Logistics staff can participate in project development by writing a Procurement and Supply Management (PSM) plan to complement each project plan. A PSM plan thoroughly details how each goal within a project plan will be practically implemented.
- Once a project is underway, a steering committee made up of medical, finance, supply chain, and other relevant personnel, can be responsible for both yearly planning and monthly evaluation of plans using common reports and communication channels;
- MedOrg can create a global policy document that provides standardized methodology for supply chain processes to help people better understand and adopt related policies.
- Policies should be followed by habitual trainings, as well as how-to guides that help staff conduct the data entry, communication, and reporting task for which they are responsible.
- Supply chain improvements should be measured by using appropriate KPIs and performance appraisal goals for all levels of staff.

QUANTITATIVE ANALYSIS – INVENTORY CONTROL MODEL

Model Selection

A combination of JRP and periodic review models were analyzed:

Model One: International (MedOrg – Logistics) Orders Only. In this model, the set policy is to use the JRP´s indirect grouping strategy (IGS) [3] to order all products from MedOrg-Logistics, eliminating all local procurement. The first variation of the model (1a) assumes that ordering from MedOrg can be done following an optimal time interval following the IGS [3]. The second variation (1b) enforces MedOrg's current policy of limiting international procurements to every six months. Once the order interval is set, MedOrg-Ethiopia uses the order-up-to model to set the maximum inventory position allowed. It then procures enough products to cover the difference between that level and the inventory position [4]. In all three models, the OUL accounts for demand and lead-time variability, as well as the use of periodic review [5].

Model Two: Two-tier ordering system from MedOrg-Logistics and local suppliers. In this model, the ordering policy is to procure enough products to meet average lead time demand from MedOrg-Logistics. Then MedOrg-Ethiopia orders from local suppliers the difference between the OUL and the inventory position (including the MedOrg-Logistics shipment) as time period for placing local orders. The time for placing orders with local suppliers based on the local lead time. Like in Model One, the ordering pattern is analyzed using both the optimal order interval (2a) and the policy of a 6 month order interval (2b).

Model Three: Local Orders Only. In this model, the ordering policy is to order all products locally, eliminating all procurement from MedOrg-Logistics. Joint replenishment is not employed because it is assumed that no one local supplier can provide all products. Instead, products are procured independently, sourced by the appropriate local supplier. The review period is 30 days, which MedOrg already uses due to the limited staff resources.

The following table visually summarizes at what interval each model would employ the different order types:

Order Policies by Model

Order Type	Reorder Point	Model				
		1a	**1b**	**2a**	**2b**	**3**
MedOrg Logistics	Optimal T*	✓		✓		
	183 Days		✓		✓	
Local	Described in models			✓	✓	✓

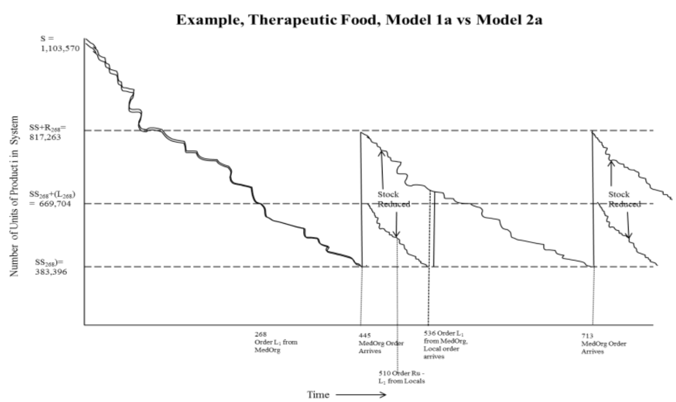
Data Collection

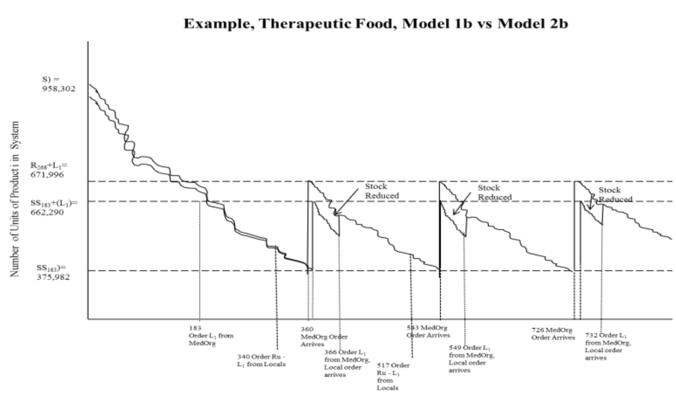
The P&L system was used to identify core products to evaluate: demand patterns; lead time variability; establish average unit prices; and look for patterns in preferences for local versus international procurement by product type. Order and holding costs were set after consulting key supply staff and referencing relevant literature. Through the process of data cleaning, a key result became clear: 23% of the data were invalid. Moreover, consumption data for most items was insufficient so procurement volumes were used as a substitute. This underlines the importance of implementing effective procedures and trainings for data entry for all staff using the system.

MODEL RESULTS

Parameter Values

Applying the input data to the unconstrained JRP models (1a and 2a) resulted in a basic order cycle of 268 days. The cycles between two successive replenishments of items ranged from 1 to 4. The longer review period required a larger safety stock, though by dividing the procurements between MedOrg-Logistics and local suppliers, the second model reduces the amount of stock necessary to have on hand. See below for an example using therapeutic food moving from Model 1a to 2a.



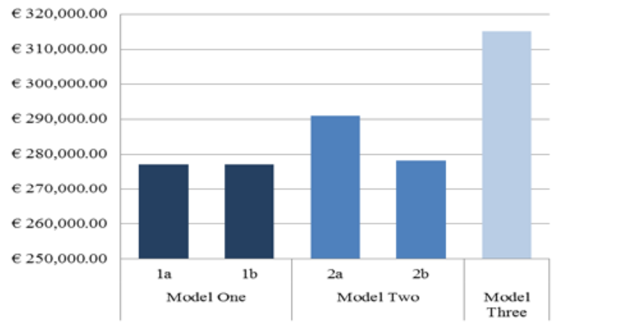


The magnitude of stock reduction is larger as the order cycle is increased, but the initial investment in stock is greater as well. The OUL for an order cycle of 283 days was 15% higher on average than the 183 day lead time across the included products. The safety stock was very high for both models because all uncertainty in the system is captured in the safety stock level. The third alternative, ordering entirely locally, reduced the OUL significantly given the elimination of the long international lead time.

Costs

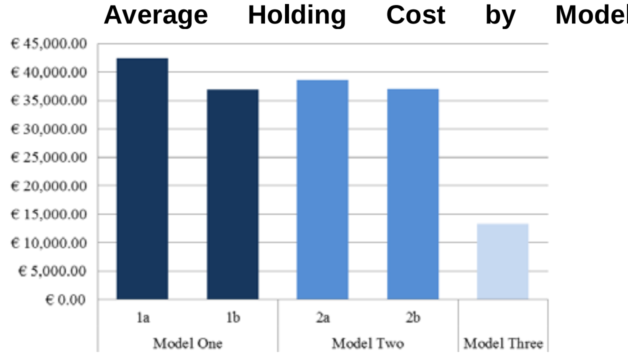
Material Costs. The unit price for the items under analysis was generally 145% higher locally rather than internationally. Thus, material costs were most expensive in Model Three. Model 2a also had high material costs because of the proportion of system stock procured locally given the long review period. The cost difference between 1b and 2b was negligible given the small time gap between the review period and the lead time.

Average Material Cost by Model

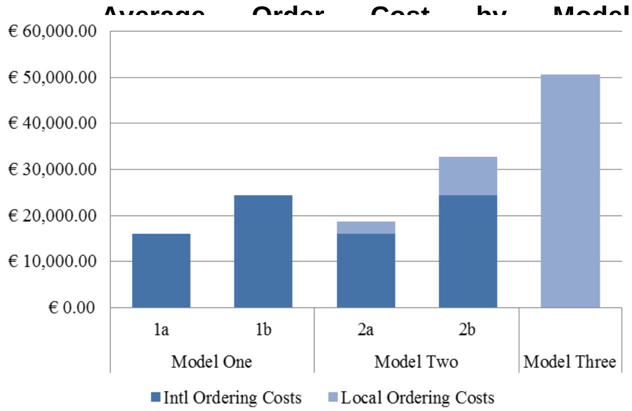


Holding Costs. Holding costs can be reduced either by decreasing the order interval, or by introducing a secondary, faster replenishment option which allows a delay in ordering and holding stock. In Model One, reducing the order cycle (Model 1a to 1b) achieved a 5,500€ savings. When flexibility was introduced (Model 1a to 2a) there was an average total holding cost reduction of 3,800€. Accordingly, Model Three had the lowest holding costs.

Average Holding Cost by Model

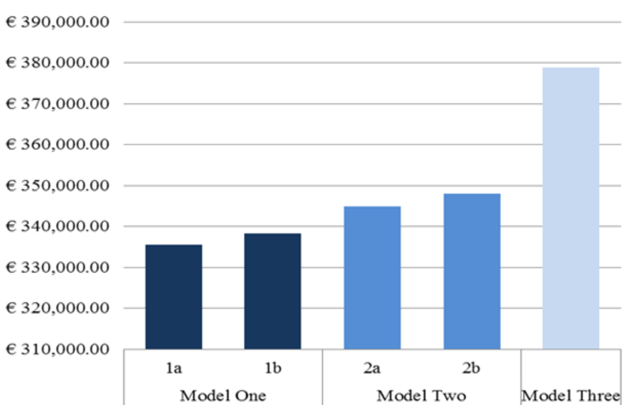


Ordering Costs. Allowing for flexibility did increase ordering costs because it introduced the additional procurement opportunity to order locally thereby increasing the number of orders in the system. Local ordering costs were less, on average, for Model 2a than 2b because not every product needed to be procured every cycle.



Total Costs. Model 1a was the most cost-effective model in this analysis. However, it is important for MedOrg to consider the benefits of the fast turnaround times provided by local suppliers. While it is slightly more expensive than relying solely on MedOrg-Logistics, it provides a realistic operational solution that balances the need for flexibility with the benefits of joint replenishment.

Average Total Cost by Model



CONCLUSION

Through the qualitative analysis, three main areas of improvement were clarified.

1. Establishing a more strategic communication structure across departments could help to align each department's yearly goals and ongoing operations.

2. Improving the Supply and Logistics Department's strategic role at both the MC and mission level could help to ensure the implementation of education and monitoring and evaluation schemes for supply chain improvement.

3. Creating clear policies and procedures that focus on standard inventory control methodology across platforms should help to establish benchmarks for operations improvement; facilitate cross-platform peer-to-peer education, and design appropriate curricula and how-to guides to assist staff in contributing to a more efficient system.

The model results:

1. Support more reliance on MedOrg-Logistics, as well as the establishment of a flexible inventory control policy;

2. Highlight the need for better data collection and further analysis of additional constraints encourage additional research on product segmentation and the role of MedOrg-Logistics in inventory replenishment. This research can help MedOrg to more accurately define its inventory policies and understand the benefits of a coordinated inventory strategy.

The relationship between the qualitative and quantitative findings is important to highlight. Without implementing recommendations like those outlined in this paper, as well as by the MedOrg's pilot team, it will be much more difficult for MedOrg to have adequate data to accurately manage inventory. Improved inventory control can increase access to medical supplies, bring down the costs of providing life-saving supplies to target populations, and ensure those supplies are available when needed. Thus, investment in inventory management simprovements is core to MedOrg's mission to deliver aid to people affected by armed conflict, epidemics, natural or man-made disasters, or exclusion from health care.

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