Toward Effective Common Operating Policies in Humanitarian Supply Operations

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The Problem

Project-specific:

—29% of consumable items were either in rupture or at risk of rupture

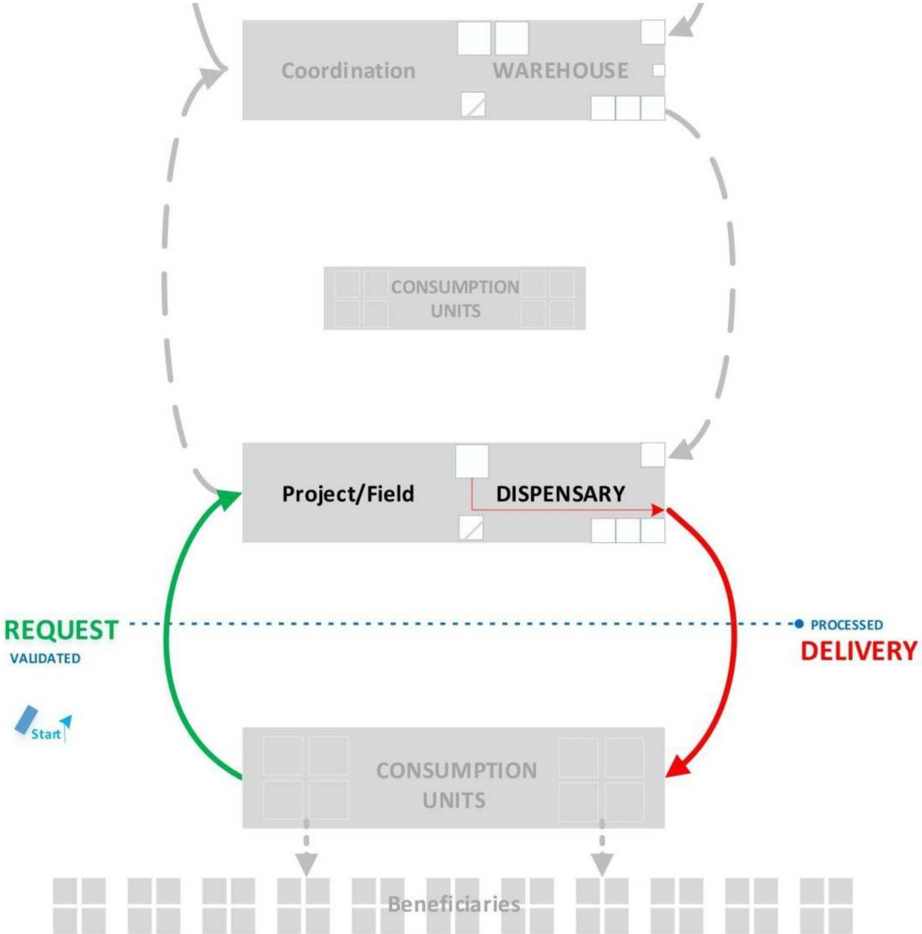
—58% of consumable items were in overstock

Organization-wide:

—60% of product forecasts result in stockout or overstock

—“quality and service correspond to the needs of humanitarian operations, whilst guaranteeing appropriate costs”

The Research Scope



The Research Question

Q: Could segmentation, or the grouping of medical items with similar characteristics and tailored inventory polices for these segments, improve item availability in ongoing humanitarian operations while maintaining appropriate costs?

The Research Answer

A: The results of such item segmentation, and the application of common operating policies, was a theoretical increase over the current rule of thumb, single operating policy by 22% in average expected item availability and a decrease in total costs of 2-8%. Yet, similar results were achieved without segmentation.

Methodology

1. Obtain a list of medical items to stock.
2. Determine candidate drivers, key drivers and their respective values.
3. Group items into segments by key drivers.
4. Assign an inventory policy per segment.
5. Evaluate.

The Analysis

1. Medical Items (n=143) to stock
2. Demand Variability, Physical Size as key drivers
3. Coefficient of Variation (CV≥1.33); Physical Size ≥ 1m³ as segment boundaries
4. Scenarios 1-5 (unsegmented | segmented)
5. Expected Item Availability & Expected Costs (Annual | Investment) adapted single-stage, guaranteed service time model

Graves, S.C., & Willems, S.P. (2000). Optimizing Strategic Safety Stock Placement in Supply Chains. *Manufacturing & Service Operations Management* Vol.2 No.1, pp. 68–83.

The Results

-Scenario 1 rule of thumb safety stock (unsegmented)

-Scenario 5 safety stock based upon variability of demand (segmented)

High variability | mid-low size | shorter review | air transport

average expected service level percent change 22%
expected annual costs + expected inventory investment percent change -8%

-Scenario 2 safety stock based upon demand variability (unsegmented)

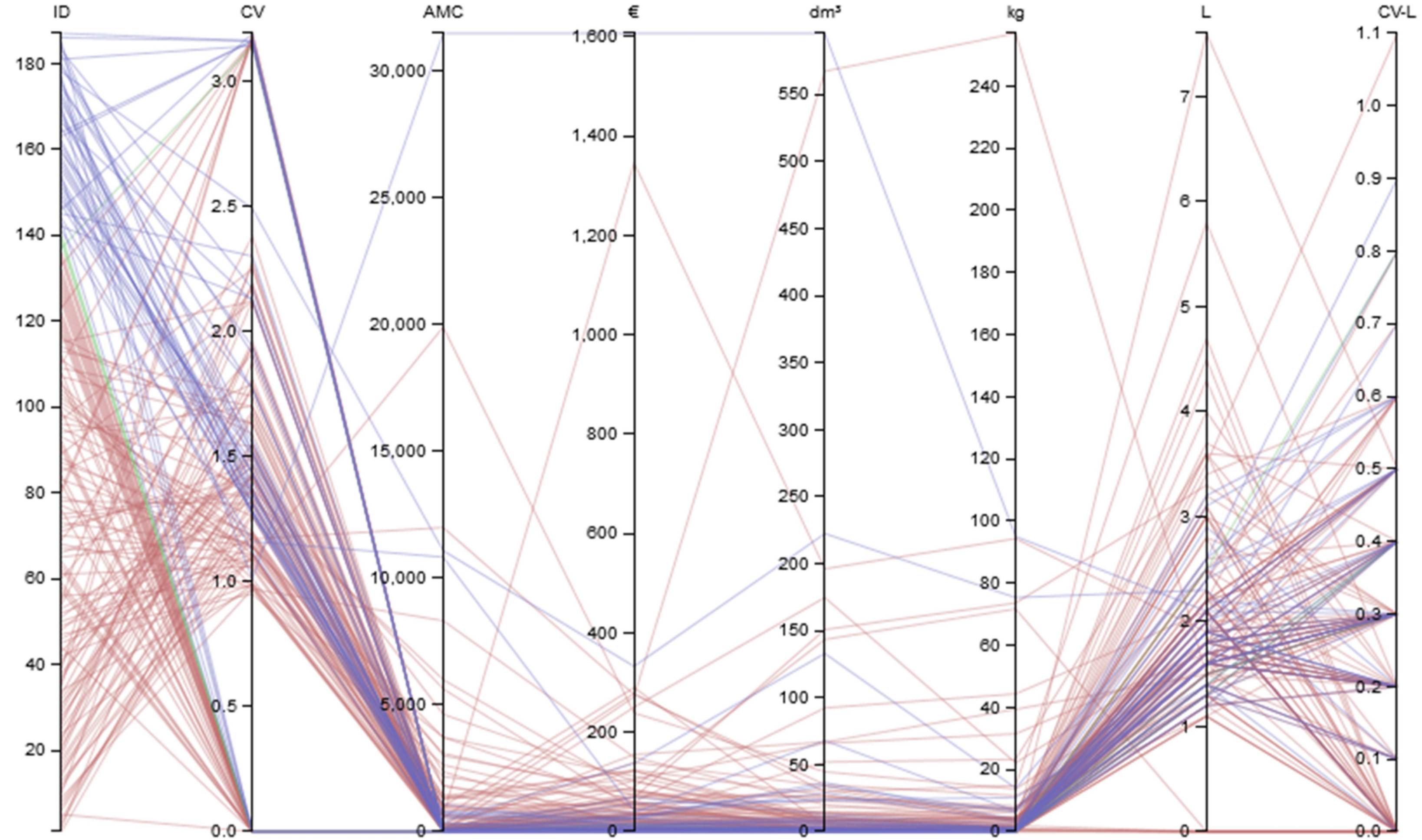
Key Insights

1. Expected item availability can improve when demand variability is formally considered.

Key Insights

2. Segmentation benefits from visual assessment, iterative analysis and formal sensitivity analysis.

Key Insights



Key Insights

3. For the practitioner, a clear, repeatable process may be preferable.

Key Insights

4. Optimization is not necessary for improvement in outcomes.

Key Insights

5. Common operating policies can allow for decisions based upon informed levels of risk.

Key Insights

1. Expected item availability can improve when demand variability is formally considered.
2. Segmentation benefits from visual assessment, iterative analysis and formal sensitivity analysis.
3. For the practitioner, a clear, repeatable process may be preferable.
4. Optimization is not necessary for improvement in outcomes.
5. Common operating policies can allow for decisions based upon informed levels of risk.

Key Challenges

1. Models. Box (1986) notes, "Essentially, all models are wrong, but some are useful."

Box, G.P.,& Draper, N.R. (1986). Empirical model-building and response surface. New York: Wiley, c. 1986.

Key Challenges

2. Math. For some practitioners in the case study, it was the belief that statistics does not have a role in inventory management.

Key Challenges

$$c_t * \frac{12}{r} + \sum_{i=1}^{N} 12 * C_i * \frac{FMC_i}{AMC_i}\mu_i + \alpha_i c_i \left(z_i \sigma_i \sqrt{\tau}_i + \frac{\mu_i r}{2} + T_i \mu_i \right) + 12 * (c_i + v_i)\sigma_i G(z_i)$$

ordering cost | procurement cost | holding cost | stockout cost

FMC_i forecasted monthly consumption (units/time)
AMC_i average monthly consumption (units/time)
μ_i average demand (average monthly consumption) (units/time)
σ_i standard deviation of demand (units/time)
r review period (time)
T stage time [lead time] (time)
v_i net replenishment time [review period + stage time] (time)
z_i safety factor (unitless)
$G(z_i)$ unit normal loss function (unitless)
α_i annual holding rate (€/inventory (€/time)
c_t fixed cost of transport (€/order)
c_i purchase cost (€/unit)
v_i variable cost of transport (€/unit)
C_i cumulative cost [purchase + variable transport] (€/unit)

Key Challenges

3. Cost. At times it appeared that any discussion of cost as regards humanitarian operations was taboo.

Key Challenges

1. Models
2. Math
3. Cost

Take-away

Segment, or perhaps don't, but formally incorporate demand variability into inventory policies for medical items in ongoing humanitarian operations.