QUANTIFIED VALUE FOR MONEY ASSESSMENT

AI-Optimized Health Supply Chain Framework
Uganda Pilot Implementation

November 2025

DOCUMENT INFORMATION

Project	Optimizing Aid Supply Chain with Local Insights in Uganda
Lead Organization	International Foundation for Recovery and Development (IFRAD)
Funding Source	Elrha Humanitarian Innovation Fund (UK FCDO)
Document Version	1.0 (Methodology Complete)
Status	Phase 1 Complete - Awaiting MOH/NMS Financial Data for Phase 2
Next Version	Version 2.0 (with quantified calculations) expected May 2026

EXECUTIVE SUMMARY
This document provides the quantified value for money (VfM) assessment framework for the offline-first AI supply chain optimization system piloted across 10 health facilities in Karamoja and Southwestern Uganda. The assessment follows the 4E Model (Economy, Efficiency, Effectiveness, Equity) to evaluate return on investment across financial and operational dimensions.

Data Availability Status
The baseline assessment (August-September 2025) captured operational performance metrics but encountered significant financial data gaps:
- Budget utilization data unavailable for 5 of 10 facilities
- Commodity expiry costs not systematically tracked at facility level
- Emergency delivery costs maintained at district level without facility-specific breakdown
- Health worker wage data held centrally by Ministry of Health

This document therefore provides:
- Complete VfM calculation methodology with worked formulas
- Verified baseline operational metrics from pilot facilities
- Clearly marked placeholders for MOH/NMS financial data
- Data collection guide for government partners to populate missing variables
- Sensitivity analysis framework for scenario modeling

Key Findings from Available Data
Baseline operational metrics demonstrate substantial improvement potential:
- All 10 pilot facilities experienced stockouts in the 12 months preceding data collection
- Average stockout duration reached 120 days at refugee-serving facilities (Nakivale)
- 89% of facilities reported unreliable connectivity, validating offline-first design requirement
- Strong negative correlation between storage capacity and stockout frequency ($r = -0.695$)
- Facilities conducting weekly inventory counts had lower stockout incidents vs. monthly counts

BASELINE PERFORMANCE DATA
The following baseline metrics were captured from 10 pilot facilities (2 regional referral hospitals, 8 spoke health centers) across four districts: Moroto, Amudat, Mbarara, and Isingiro. Data collection occurred August 25 - September 6, 2025.

Stockout Performance Indicators
Data Source: IFRAD Baseline Assessment Report (October 2025), 33 quantitative surveys, 31 key informant interviews

Indicator	Baseline Value
Facilities experiencing stockouts	10 of 10 (100%)
Average stockout duration (remote facilities)	Up to 120 days (Nakivale base camp)
Connectivity reliability	Unreliable at 89% of facilities
Storage capacity-stockout correlation	$r = -0.695$ (strong negative)
Emergency procurement frequency	Quarterly to monthly at HC III facilities

PROJECTED IMPROVEMENTS

The following improvements are specified in the technical validation report and project proposal based on the offline-first AI framework design with three-tier forecasting architecture.

Performance Area	Target Improvement	Source
Stockout duration reduction	40% reduction in stockout days	Needs Assessment Report Dec 2024
Delivery delay reduction	30% simulated reduction in rainy season delays	Needs Assessment Report Dec 2024
Forecast accuracy (Tiers 2-3)	≥85% prediction accuracy (k-fold validation)	Needs Assessment Report Dec 2024
Ordering cycle time reduction	From 2 weeks to 2 days per cycle	Technical Validation Report
Equity target	≤5% accuracy disparity urban/rural	Needs Assessment Report Dec 2024

FINANCIAL ROI CALCULATION

Financial ROI measures cash-releasable savings through reduced waste (expired commodities) and avoided emergency logistics costs.

Formula

$$ROI = \frac{[(\text{Expiry Savings} + \text{Logistics Savings}) - \text{Operating Cost}]}{\text{Operating Cost}} \times 100$$

Variable Definitions and Data Status

Variable	Definition	Data Source / Status
Expiry Savings	(Baseline Expiry Rate - Current Expiry Rate) × Unit Cost × Annual Volume	**MOH/NMS REQUIRED** - Expiry tracking not facility-level
Logistics Savings	(Baseline Emergency Runs - Current Emergency Runs) × Cost per Run	**MOH/NMS REQUIRED** - District maintains costs
Operating Cost	Annual server hosting + maintenance + technical support	**PROJECT DATA** - £50,000 GBP (convert at Bank of Uganda exchange rate)

Worked Example with Placeholder Values

The following calculation demonstrates methodology using hypothetical values. MOH/NMS must replace placeholders with actual financial data.

Component	Value (UGX)
Baseline annual expiries (value)	**[PLACEHOLDER - MOH/NMS DATA]**
Projected expiries with AI system (40% reduction)	*[AUTO-CALCULATED FROM BASELINE]*
Expiry Savings	*[AUTO-CALCULATED]*
Baseline emergency runs per year (all facilities)	**[PLACEHOLDER - MOH/NMS DATA]**
Cost per emergency run (fuel, per diem, vehicle)	**[PLACEHOLDER - MOH/NMS DATA]**
Projected emergency runs (30% reduction)	*[AUTO-CALCULATED FROM BASELINE]*
Logistics Savings	*[AUTO-CALCULATED]*
Annual operating cost	[UGX EQUIVALENT OF £50,000 using Bank of Uganda rate Dec 31, 2025]
FINANCIAL ROI	***[CALCULATED UPON DATA INPUT]***

SOCIAL RETURN ON INVESTMENT (SROI)

SROI monetizes efficiency gains by valuing staff time freed from manual ordering processes and redirected to direct patient care.

Formula

Value of Time Released = Hours Saved per Cycle × Cycles per Year × Average Hourly Wage

Variable Definitions and Data Status

Variable	Definition	Data Source / Status
Hours Saved per Cycle	Baseline time (2 weeks = 80 hours) - Projected time (2 days = 16 hours) = 64 hours saved*	**TECHNICAL VALIDATION** - 64 hours per cycle
Cycles per Year	Number of ordering cycles conducted annually per facility	**MOH DATA REQUIRED** - Typically 12 (monthly) or 4 (quarterly)
Average Hourly Wage	Blended hourly rate for health workers involved in ordering (pharmacists, clinical officers)	**MOH REQUIRED** - Central payroll data

Time Calculation Basis: *Based on Technical Validation Report findings, facility staff currently spend approximately 1 week of combined staff time collecting data from paper records, preparing orders manually, and entering information into multiple disconnected systems (DHIS2, eAFYA, CSSP). The AI system reduces this to 2 days for data review and order approval only, as the system auto-generates orders and produces consolidated reports. Calculation assumes standard 40-hour work weeks (80 hours = 2 weeks, 16 hours = 2 days).*

Worked Example (10 Pilot Facilities)

Component	Value
Hours saved per ordering cycle	64 hours
Ordering cycles per facility per year	**[PLACEHOLDER - MOH DATA, assume 12]**
Number of pilot facilities	10
Total hours saved annually (all facilities)	64 × 12 × 10 = 7,680 hours
Average hourly wage (UGX)	**[PLACEHOLDER - MOH PAYROLL]**
SROI (Monetized Time Value)	*[CALCULATED UPON DATA INPUT]*

Interpretation: This monetized value represents health system efficiency gains. Staff can redirect freed time to direct patient care, reducing referral rates and improving service quality. This is classified as 'time-releasable' rather than 'cash-releasable' value.

Important limitation: *This SROI calculation captures only the monetized efficiency gain from reduced administrative burden. It does not account for the health outcomes from improved supply availability (reduced mortality from stockouts, prevented disease complications due to medicine availability, improved maternal health outcomes). These health outcomes represent the primary value proposition but are difficult to monetize in a 6-month design phase without operational deployment data.*

DATA COLLECTION GUIDE FOR MOH/NMS

This section specifies the exact financial data required from Ministry of Health and National Medical Stores to populate the VfM calculations. Data requests are organized by responsible entity and include collection methods.

National Medical Stores (NMS) Data Requirements

Data Element	Specification	Collection Method
Commodity Expiry Value	Total UGX value of expired medicines and supplies at 10 pilot facilities in preceding 12 months (Aug 2024 - Aug 2025)	NMS invoices matched to facility expiry reports from facility stock cards
Top 10 Expired Commodities	List of most frequently expired items with unit costs (for forecasting model weighting)	NMS procurement database aggregated by commodity
Emergency Delivery Costs	Average cost per emergency delivery (fuel, driver per diem, vehicle depreciation)	District fuel logs and vehicle manifests aggregated

Ministry of Health Data Requirements

Data Element	Specification	Collection Method
Health Worker Wage Data	Average gross hourly wage for pharmacists and clinical officers involved in supply ordering	MOH payroll system (annual salary / 2,080 hours)
Ordering Cycle Frequency	Number of supply ordering cycles per facility per year (monthly = 12, quarterly = 4)	District health office procurement schedules
System Operating Costs	Projected annual hosting, maintenance, and technical support costs in UGX (convert £50,000 GBP at Bank of Uganda exchange rate Dec 31, 2025)	MOH budget office using Bank of Uganda official exchange rate

Data Validation Protocol

To maintain calculation integrity, MOH/NMS should follow this validation process:
- Verify expiry data against facility-level stock cards to avoid double-counting
- Cross-reference emergency delivery costs against district fuel logs
- Calculate blended hourly wage including benefits, not just base salary
- Document assumptions made for any estimated values
- Use Bank of Uganda midpoint exchange rate as of December 31, 2025 for all GBP to UGX conversions
- Obtain district health office sign-off before finalizing calculations

SENSITIVITY ANALYSIS FRAMEWORK

Given uncertainty in baseline financial data, sensitivity analysis models how VfM outcomes vary under different scenarios. This allows MOH and donors to understand the range of plausible ROI outcomes.

Key Variables for Scenario Modeling

Variable	Conservative Scenario	Optimistic Scenario
Stockout reduction	20% reduction	50% reduction
Expiry reduction	15% reduction	40% reduction
Emergency delivery reduction	20% fewer runs	40% fewer runs
Time savings per cycle	40 hours saved	80 hours saved

Break-Even Analysis

A neutral Financial ROI (0%) indicates the system pays for itself through waste reduction without generating additional cash savings. This still represents value through Effectiveness (stockout reduction) and Equity (service leveling) gains.

Break-even conditions can be calculated as:

$$\text{Minimum Required Savings} = \text{Annual Operating Cost}$$

Once MOH/NMS provides baseline financial data, this document will be updated with break-even thresholds for expiry rates and emergency delivery frequencies.

NEXT STEPS AND DATA COLLECTION TIMELINE

Timeline	Activity	Responsible Party
January 2026	Submit data request to NMS and MOH with specific variable definitions from Section 6	IFRAD project team
February 2026	Extract financial data from NMS invoices, district fuel logs, and MOH payroll system	NMS procurement unit, District Health Offices, MOH Budget Office
March 2026	Validate data using protocol in Section 6.3, obtain district sign-off	IFRAD + District Health Teams
April 2026	Populate VfM calculations, run sensitivity analysis, produce final quantified report	IFRAD project team
May 2026	Present final VfM findings to MOH stakeholders and HIF donor	IFRAD + MOH + Elrha HIF

Data Availability and Quantification Pathway: The timeline above represents the technical process for completing quantified VfM calculations once MOH/NMS provides the specified financial data. IFRAD has fulfilled the design phase deliverable by providing complete methodology, verified operational baseline metrics, and detailed data collection protocols.

The primary constraint preventing quantification has been systematic financial data gaps discovered during baseline assessment: budget utilization unavailable for 5 of 10 facilities, expiry costs not tracked at facility level, and emergency delivery costs maintained only at district level without breakdowns. These gaps reflect broader information system challenges in Uganda's health supply chain - the same challenges the AI framework is designed to address.

The submitted VfM methodology is complete and ready for use. Quantification can proceed once government partners extract the specified financial data from their existing systems (NMS invoices, district fuel logs, MOH payroll). The methodology is designed to be implementable by any partner with access to this data - whether IFRAD, MOH directly, another implementing organization, or a future funder. This approach ensures the framework's VfM assessment capability is not dependent on any single organization's capacity or timeline.

ANNEX A: GLOSSARY OF TERMS

Term	Definition
4E Model	Framework evaluating Economy (spending less), Efficiency (spending well), Effectiveness (spending wisely), and Equity (spending fairly)
Cash-releasable	Savings that could theoretically be returned to the budget (e.g., reduced expiries, fuel costs)
Time-releasable	Staff time freed from administrative tasks, redirected to patient care (valued through SROI)
MAPE	Mean Absolute Percentage Error - forecast accuracy metric measuring average deviation between predictions and actual consumption
Offline-first	Design principle where systems function fully without internet, syncing when connectivity available
Three-tier forecasting	Tier 1: Rule-based (offline facilities), Tier 2: Hierarchical statistical (intermittent connectivity), Tier 3: Machine learning (district/central)
Tracer commodities	Key essential medicines monitored for stockout tracking (e.g., antimalarials, antibiotics, contraceptives)

DOCUMENT CONTROL

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Related Documents	Baseline Assessment Report (Oct 2025), Technical Validation Report, System Architecture v2.0, Integration Standards v2.0

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