



Swaziland Warehouse Management Technical Assistance Report

April 2013



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SIAPS 
Systems for Improved Access
to Pharmaceuticals and Services

Swaziland Warehouse Management Technical Assistance Report

Roger Miller
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April 2013



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The SIAPS logo consists of the word "SIAPS" in a bold, green, sans-serif font, followed by a stylized blue graphic of a person with arms raised in a 'V' shape.

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About SIAPS

The goal of the Systems for Improved Access to Pharmaceuticals and Services (SIAPS) Program is to assure the availability of quality pharmaceutical products and effective pharmaceutical services to achieve desired health outcomes. Toward this end, the SIAPS result areas include improving governance, building capacity for pharmaceutical management and services, addressing information needed for decision-making in the pharmaceutical sector, strengthening financing strategies and mechanisms to improve access to medicines, and increasing quality pharmaceutical services.

Recommended Citation

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CONTENTS

Acronyms and Abbreviations	iv
Acknowledgments.....	v
Executive Summary	vii
Introduction.....	1
Background.....	3
Understanding of the Problem	5
Findings and Recommendations	7
Governance of Swaziland’s Health Commodity Supply Chain.....	7
Business Practices and Operating Procedures	11
Supply Chain Simulation and Options.....	12
Conclusions.....	17
Annex A: Sites Visited and Persons Contacted.....	19
Annex B: Standard Operating procedures	21
Annex C: Supply Chain Guru Presentation	39

ACRONYMS AND ABBREVIATIONS

ARV	antiretroviral
BoD	Board of Directors
CAPA	Corrective Action/Preventive Action
CMS	Central Medical Store
HAZMAT	hazardous materials
IM	inventory management
MoH	Ministry of Health
MSDS	Material Safety Data Sheet
NGO	nongovernmental organization
NLW	National Laboratory Warehouse
QA	quality assurance
QC	quality control
QCU	Quality Control Unit
SCG	Supply Chain Guru
SIAPS	System for Improved Access to Pharmaceuticals and Services
SOP	standard operating procedure
TWG	Technical Working Group

ACKNOWLEDGMENTS

The technical assistance team would like to thank the entire staff of the Ministry of Health (MoH) of Swaziland for the opportunity to learn about their mission and the challenges facing the organization. We hope the approach to this initial technical assistance and the recommendations that resulted will be useful in informing important decisions for the program's future.

This technical assistance was greatly assisted by Kidwell Matshotyana, Country Director, Systems for Improved Access to Pharmaceuticals and Services (SIAPS) program, implemented by Management Sciences for Health (MSH). His astute understanding proved invaluable. The team understood both his intent and personal desire to see productive outcomes on behalf of the MoH. Special thanks are extended to the entire SIAPS staff for their exceptional efforts to organize and facilitate all aspects of the field and office visits necessary to conduct the assessment.

We wish to express our sincere appreciation to the SIAPS Program, US Agency for International Development, and MSH for providing funding, leadership, and technical support for this visit.

EXECUTIVE SUMMARY

Swaziland, a small, landlocked southern African kingdom with 1.185 million citizens, is fighting a daunting public health battle against HIV and AIDS, a disease for which the country has the world's highest adult incidence rate. The country is also battling high rates of tuberculosis and multiple-drug-resistant tuberculosis. As Swaziland has expanded its response to these and other diseases over the last several years, its Ministry of Health (MoH) has increasingly emphasized the efficiency and effectiveness of the health commodity supply chains that support the nation's public health service delivery.

To help the ministry understand the strengths, weaknesses, opportunities, and threats in Swaziland's public health medical supply chain, staff from LMI's Health Systems Management directorate studied relevant operating procedures and other documentation; conducted a country visit August 10–26, 2012; and developed a complex, multivariate supply chain simulation exercise, including storage facility and transportation optimization excursions. The team also reviewed current Swaziland medical supply chain governance, warehouse operation flows and procedures, fleet management, storage capacity, and oversight processes and structures and developed a number of alternative recommendations to guide a future optimized supply chain system.

The review of the operating procedures indicated that the existing standard operating procedures (SOPs), developed with technical assistance from the Strengthening Pharmaceutical Systems Program for central medical stores (CMS) and facility stores operations, are state of the art and ready for full implementation throughout the country. The review also found that physical storage facility guidance and procedures have not yet been developed. Annex B to this report contains a detailed set of physical storage practices and procedures recommended as an addendum for the existing CMS SOP on physical medical supply and pharmaceutical storage.

For the Swaziland public health supply chain simulation exercise, a commercial supply chain simulation software product from LLamaSoft, Inc., called Supply Chain Guru (SCG) was used. With SCG, a geographically based model of the Swaziland supply chain—including customer locations and product demand patterns, road and transport capabilities, and storage capacities and locations—was built. The model demonstrated that Swaziland can realize efficiency benefits by changing its storage practices from commodity-specific storage facilities (central medical, antiretroviral [ARV], and laboratory commodities) to commodity-agnostic storage facilities (by “commodity agnostic” means storage facilities used to store any medical commodity a facility is capable of storing safely and securely)—essentially an integrated supply system. The model also demonstrated that Swaziland can more efficiently use its limited transport capacity by shifting to commodity-agnostic transport practices. Additional work is needed to further refine improved transport route maps to increase the efficiency and effectiveness of support to supply chain customers, who are geographically dispersed across the Swazi nation.

The governance and oversight review indicated that the country's use of a medical supply chain Technical Working Group (TWG) (an interagency and cross-functional body that coordinates medical supply chain issues across the government and nongovernmental organization [NGO]

communities) is entirely appropriate and yielding excellent results. However, further expansions of the TWG’s responsibilities and authority will enable future improvements in supply chain management. This report recommends a two-phase expansion of the current TWG. First, enhance TWG membership and scope in a “TWG+” phase that would last for approximately 12–24 months. Second, the MoH should begin planning now to establish a formal, semi-autonomous health commodity supply chain governance body, constituted by the Prime Minister and chartered as a board of directors (BoD). The establishment of a formal BoD will provide the government of Swaziland, donor organizations, and key NGOs with a collaborative, balanced, and fully accountable means of identifying, addressing, and resolving important supply chain issues now and in the future.

In summary, the report’s key recommendations are as follows—

- Adopt and implement an SOP to define physical storage operations and management.
- Adopt new, commodity-agnostic storage practices to improve the efficiency of physical space management and work flows.
- Continue transportation route planning and refinement to optimize transportation efficiency throughout Swaziland.
- Establish and refine a Swaziland medical supply chain BoD to improve efficiency, transparency, and accountability of the medical supply chain at all levels, from the CMS operation to the point of care.

As measured against pharmaceutical supply chains in other developing nations, Swaziland has a well-functioning system. Gaps remain—for example, stock-outs occur with unacceptable frequency—but it is relatively efficient, modern, transparent, and effective. Key managers and stakeholders work in a highly collaborative, problem-solving environment, and that is a vital enabler to Swaziland’s remarkable national response to its most severe health problems. With further continued progress along the lines suggested in this report, the future of managing public health commodities in Swaziland should be on a positive trajectory to continual improvement.

INTRODUCTION

At the request of the Systems for Improved Access to Pharmaceuticals and Services (SIAPS) program, implemented by Management Sciences for Health and SIAPS, LMI visited the kingdom of Swaziland in August 2012 to conduct an assessment of the MoH's health commodity supply chain operations. The purpose of the technical assistance visit was to review and propose a comprehensive warehousing, inventory management, and distribution management plan for Swaziland MoH health commodities. The CMS for essential medicines, the CMS for HIV commodities, and the National Laboratory Warehouse (NLW) were visited to collect data for the assessments. A team consisting of representatives from the CMSs, the US Agency for International Development, SIAPS, and LMI travelled to two different regional hospitals to assess their supply operations. The team found generally modern facilities, good and rapidly improving information, sustained communication and technology support, and leaders and workers eager and open to change. Furthermore, the supply chain has a reasonably well developed transport network with some challenges in vehicle availability, warehouse SOP development, warehouse space management, transportation management, and pharmaceutical supply chain governance. This report covers these areas in more detail, along with recommendations and possible improvements.

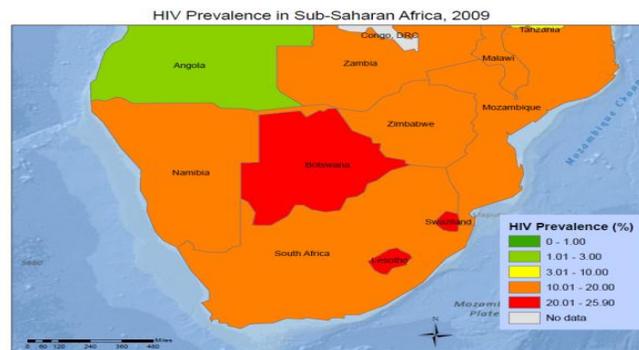
BACKGROUND

The MoH in Swaziland is running three large warehouses: a CMS facility for general medical supplies, a warehouse for ARV therapy products, and the NLW for laboratory products. In addition, it has a nonmedical and surgical products warehouse and a smaller storage facility for flammables. These facilities have responsibility for distribution of health products throughout the country. In addition, nine storage structures support hospitals and health centers throughout the country, one of which is a stand-alone storage facility. These nine structures are somewhat misleadingly called regional warehouses whereas in actuality they support only the facility to which they are attached.

All of the storage facilities are supported by good and rapidly improving information systems that enable enterprise-level management of the medical supply chain countrywide. These systems include SIAPS's RxSolutions application, which automates pharmaceutical and medical inventory management, ordering, receiving, and storage processes. Currently SIAPS is supporting the CMS and NLW to develop strategies to improve inventory control and warehouse operations management. In collaboration with SIAPS, the MoH has identified a gap in warehousing and distribution of health products, including coordination of fleet management for delivery to facilities. The MoH also needs improved SOPs to standardize warehouse work flows and warehouse operations for the central storage facilities. Finally, the MoH is seeking guidance on operational integration of the supply chain from the central stores to the hospital or clinic levels, as well as national-level governance and policy oversight of Swaziland's supply chain.

UNDERSTANDING OF THE PROBLEM

Swaziland faces daunting health challenges. It has the highest HIV prevalence rate in the world, currently at 26 percent among population 15 to 49 years of age (2006/2007, World Health Organization Demographic and Health Survey). In 2009, mortality from AIDS-related causes amounted to 0.6 percent of the population (about 7,000 of a total population of 1.185 million). Since 2004, when Swaziland first officially acknowledged the AIDS crisis, it has mounted an impressive response. According to the 2011 *UNAIDS World AIDS Day Report*, Swaziland is close to achieving universal access to HIV and AIDS treatment.¹



Source: United Nations Joint Programme on HIV/AIDS (UNAIDS). 2010. *UNAIDS Report on the Global AIDS Epidemic 2010*. Geneva: UNAIDS.

Figure 1. HIV prevalence in southern Africa, 2009

The massive accelerated response to diagnosing and treating HIV and AIDS in the general population has introduced a significant stress in the supply chain. Staff, facilities, transport resources, and organizational capacity have all been stretched to their maximum capability and require processes, tools, systems, and policy oversight changes to enable them to perform at the new, higher standard required.

To support this analysis and provide data-driven recommendations about the changes needed the review used a commercial supply chain design software product, SCG, from LLamaSoft Inc. The results of the geographic information system–based SCG analysis are depicted and described throughout this report in both graphical and narrative form.

¹ United Nations Joint Programme on HIV/AIDS (UNAIDS). 2011. *UNAIDS World AIDS Day Report 2011*. Geneva: UNAIDS.

http://www.unaids.org/en/media/unaids/contentassets/documents/unaidspublication/2011/JC2216_WorldAIDSday_report_2011_en.pdf.

FINDINGS AND RECOMMENDATIONS

Governance of Swaziland's Health Commodity Supply Chain

As Swaziland and its donors have ramped up to meet the country's health challenges, the sophistication and responsiveness of the health commodity supply chain has had to grow accordingly. Modernizing the governance of the supply chain—the policy direction, oversight, and integration into the broader public health system—is increasingly important.

A well-governed, national-level health commodity supply chain governance approach has two core attributes that require exploration. The first is the overall medicines regulatory framework at the national level (which is beyond the scope of this report), and the second is a health commodity supply chain governance structure. This report focuses on the supply chain governance dimension in the paragraphs that follow.

A Health Commodity Supply Chain Governance Structure

Recently, the MoH has established what appears to be a highly successful Health Commodity Supply Chain TWG for interagency coordination of supply chain issues. The group is chaired by the ministry's Director of Health Services, in which SIAPS is serving as Secretariat. Members include representatives of the following—

- MoH
- PwC, the local fund agency for the Global Fund to Fight AIDS, Tuberculosis and Malaria
- Clinton Health Access Initiative
- US President's Emergency Plan for AIDS Relief
- National Emergency Response Council on HIV/AIDS (NERCHA)
- Médecins Sans Frontières (Doctors Without Borders)
- United Nations Population Fund (UNFPA)
- Other local governmental and nongovernmental organizations

The TWG's charter calls for it to integrate the supply chain efforts of the tuberculosis, malaria, HIV and AIDS, laboratory, general medical supplies, general pharmaceuticals, and reproductive health commodities within Swaziland. The TWG also intends to integrate efforts in different components of the supply chain (for example, the CMS and procurement components). Standardization of business processes and products within and across these commodity types is also a TWG objective.

Discussion

The TWG provides an excellent forum within which active collaboration on supply chain issues, results, opportunities, and stakeholders can take place. By its own admission, though, the TWG is in the early stages of its development as an interagency coordinating body. Although it is an evolving organization, it has the potential to serve as the starting point for an improved governance process for the Swaziland public health supply chain. There are two logical phases,

or steps, in the progression from today's partly integrated supply chain to one that is high performing, fully integrated, and collaboratively managed.

Operation of the Central Medical Stores Facility

Before—or at least in parallel with—the implementation of governance enhancements, the CMS operation in Matsapha should be strengthened organizationally. Its continued smooth and uninterrupted operation is an essential foundation for an improved national-level medical supply chain. Accordingly, a single internal change could serve to both strengthen the CMS operation and simultaneously enable an executive focus on broader strategic-level supply chain improvements.

To enable achievement of the country's broader objectives while ensuring that day-to-day details of the stores operation are attended to, the ministry should consider recruiting a Central Medical Stores Warehouse Operations Manager with reporting responsibility to the Director, Central Medical Stores. This person would have detailed, day-to-day oversight of the physical management of all warehouse operations, including management of receiving, storekeeping, and shipping functions. The warehouse operations manager would not be responsible for procurement, quality assurance, inventory and financial accounting, and other front-office CMS functions, oversight of which should be retained by the "Director" of CMS. In essence, the responsibility of the warehouse operations manager would be to implement and refine the physical warehousing operating procedures described in annex B of this report.

The Director of CMS should focus on the development and implementation of a strategic, long-range pharmaceutical supply chain vision that integrates the entire nation's health commodities supply operation. The director's responsibilities also include overseeing the nation's nine regional warehouses and coordinating among different partners supporting the design and implementation of an efficient and integrated health commodity supply chain system. The director's future responsibilities could encompass all health facilities rather than just the nine regional pharmacy operations. Accordingly, the overarching objective of recruiting a new warehouse operations manager would be to enable the Director of CMS to concentrate on these broader, national-level responsibilities.

Key duties of the warehouse operations manager could include—

- Development and implementation of physical storage and space management SOPs, forms, work flow processes, and tracking and reporting systems for the CMS facilities.
- Day-to-day oversight and management of CMS facilities, including receipt, storage, and issue of all health commodities.
- Management and ongoing modernization of storage facilities, materials handling equipment, physical security systems, cold-chain management activities, and installed racking and storage systems.
- Human resources management, including training and capacity building, for storekeepers, forklift operators, physical inventory specialists, drivers, and other nonclinical CMS staff.

Summary: Enhancing the Governance of the Swaziland Health Commodity Supply Chain

The paragraphs that follow provide a recommended pathway to help Swaziland move toward enhanced governance of the supply chain system. Again, these can be viewed as phases in the process.

Initial Governance Enhancement: TWG+

The first step to enhancing the governance of the Swaziland public health supply chain is to strengthen and enhance the TWG by (a) enhancing its membership and (b) strengthening its functions.

Discussion

Enhancing TWG Membership

The TWG members have already suggested adding additional members to their ranks. Formal inclusion of the appropriate NGO stakeholders should be accomplished as soon as possible. Note that the role of these nongovernmental entities may be as observers or nonvoting members, with voting membership limited to MoH and other Swazi officials. A clear, consistent approach to the issue of voting privileges and TWG membership is important in the short term, but even more important in the subsequent phases as the TWG moves into a true health commodities supply chain governance role.

TWG membership does not currently include all the pharmacists from the regional store locations, but their participation is important to be sure that performance and capacity variations among and between regions is understood. A recommendation would also be to ensure that at least one regional pharmacist be added to the TWG membership. The current TWG membership does not include any true customer representatives, such as representatives from hospitals or Regional Health Management Teams. The team also recommends that at least one customer representative be added to the TWG membership.

Within the separate commodity types represented in the TWG (e.g., laboratory supplies or ARVs), efforts are already under way to standardize the devices and products in use. This standardization work should help reduce the number of items managed in the commodity supply chains and therefore reduce the cost and complexity of their operation. More work is possible to standardize items and processes used across all commodities throughout the entire health commodity supply chain. The TWG is the logical focal point for that cross-commodity standardization.

The TWG also needs to develop an accountability matrix and action plan to clearly define its activities and the roles of each member in strengthening supply chain systems. Development of such a plan will improve the transparency and accountability of TWG operations while simultaneously strengthening formal and informal member buy-in and collaboration. The TWG action plan should be developed by a selected subset of TWG members who are constituted as a

TWG subcommittee for the 60–90 days required for developing a draft plan. The draft action plan should then be voted on and approved (with required modifications) by the full TWG.

Strengths and Weaknesses

The inherent strength of enhancing the roles and membership of the TWG is that it moves Swaziland toward a more broadly accountable, transparent, and effective health commodity supply chain, with better inter- and intra-agency communications and logistics management between governmental and nongovernmental organizations.

An enhanced TWG also provides a platform for improved information sharing, communication, and information technology (IT) planning and implementation. As IT capabilities become more widely available, lead times are reduced, and platforms shift from desktop and laptop to mobile devices, an enhanced planning group such as the TWG provides a forum in which requirements can be consolidated, capabilities can be standardized, and lessons learned can be shared among customers, program managers, and IT specialists.

The key weakness of an enhanced TWG is that it complicates and possibly slows decision making. It has the potential to greatly enhance the ability of the Director for CMS and his or her commodity counterpart to support customers and respond to donors, but it does complicate their oversight and governance responsibilities. The strengths of this recommendation clearly outweigh the weaknesses, but the weaknesses should be noted.

Final Governance Enhancement: Establishing a Health Commodity Supply Chain BoD

The final step toward true enterprise-level supply chain governance in Swaziland is to establish a BoD with true governance powers and responsibilities.

Discussion

This final step would involve the establishment of a chartered CMS BoD with defined authority, regular meeting frequency, and responsibility to establish by-laws and other formal documents to regulate and define its functions and the functions of the organizations it oversees.

Although a board meeting room exists in the CMS facility in Matsapha, the team was told no board has ever been convened in that space. This recommendation is an effort to “breathe life into” the concept of a BoD.

In a public health system, the BoD members are trustees, reflecting their acceptance of assets in trust for the community and the acknowledgment that the medical supply chain public health assets are to be used for the health needs of the community. Consistent with Swaziland laws, the BoD members should not be compensated, except for out-of-pocket expenses. They should be able to sell assets or discontinue services only when they are no longer necessary, and significant legal barriers should prevent their liquidating or transferring public health assets.

The board’s key functions should include—

- Appointing a chief executive for the Swaziland health commodity supply chain
- Establishing a long-range plan health commodity
- Approving the annual budget
- Establishing committees and appoint committee members as needed
- Overseeing clinical credentials needed to manage and operate the health commodity supply chain
- Monitoring performance against plans and budgets

Note that a health commodity supply chain BoD, though based in the idea of a CMS BoD, has substantial responsibilities beyond those of the CMS operation itself. In this construct, the BoD has enterprise-level responsibility for the end-to-end operation of the Swaziland medical supply chain.

Strengths and Weaknesses

The strengths of a chartered, fully constituted, functioning BoD are substantial—

- It provides the MoH and the Principal Secretary for Health a clear line of accountability and authority to manage the country's entire supply chain.
- It provides an executive-level forum within which other important supply chain stakeholders, such as the Ministry of Planning and the Ministry of Finance, can coordinate plans, requirements, and activities on a long-range, strategic basis.
- It provides external stakeholders such as NGOs and donors with an important channel through which to voice and advance long-range, strategic goals and objectives.

The team was able to identify only one weakness to this recommendation: it may take some time (6–12 months) to charter, establish, and convene the BoD, and some longer time (12–18 months) before it can effectively govern. In the meantime, the transition from the existing TWG, to the TWG+, and onward to the BoD, must be carefully managed. The team explored a number of organizational alternatives, including the status quo, to enable better performance of the Swaziland health commodity supply chain. The alternatives range from making no organizational changes and issuing only improved policies and procedures (the status quo) to progressively more defined governance structures that would exercise the increasing amounts of organizational control over the health commodity supply chain.

Each of the options studied is described in detail below, including an assessment of the strengths and weaknesses of each.

Business Practices and Operating Procedures

Swaziland has an excellent series of SOPs for health commodity supply chain management, all of which are recently developed, reflect best business practices for the management of medical product and pharmaceutical supply chains, and are currently being implemented by staff within the MoH. The team found no deficiencies with any of those documents and commends the MoH

for creating such far-reaching products with the support of the Strengthening Pharmaceutical Systems Program.

One functional area not addressed in the existing SOPs is the physical management of products, storage facilities, and transport vehicles. To address this gap, an addendum was developed (see annex B to this report). Annex B contains an item-by-item list of procedures and functions to enable the creation of a new SOP to address physical warehouse and transport management.

These SOPs address procedures on physical space management, training and credentialing, physical security and fire safety, record keeping, and other procedural guidance. The SOPs are intended as a complete, exhaustive list of practices and procedures needed to run clean, modern, and efficient health commodity supply storage facilities.

Supply Chain Simulation and Options

For the supply chain simulation part of this project, a commercially available supply chain simulation software product called Supply Chain Guru, has been used. SCG is in wide use in US and international companies, including a number of public health providers in sub-Saharan Africa. Methodologies and key findings are highlighted below; the analytic details of the work with SCG are in annex C.

SCG Methodology for Swaziland

The ability to use SCG to analyze Swaziland's health commodity supply chain was based on the availability of a substantial amount of useful, current, and complete data to describe the country's health commodity supply chain operations. From RxSolutions, MoH Strategic Information Department, CMS, and SIAPS Swaziland staff, the team was able to obtain robust data about virtually all aspects of the supply chain.

Good data, in usable form, were easily obtained about the numbers, types, and specific locations of all 171 health commodity supply customers (points of use or dispensing facilities). The team also obtained complete, reliable data from the SIAPS-developed RxSolutions information application about the 1,551 products routinely used within the supply chain. Furthermore, RxSolutions provided data about how those products were grouped into the major commodity and storage types of laboratory supplies, pharmaceutical and general medical supplies, and ARV supplies. Product-level data included customer-level demands by month and uniformly used product identification data valid for all levels of product use within the country.

The overall size information in cubic meters about the three central stores facilities and the nine "regional" warehouses supporting the regional pharmacy operations have been collected. Physical spaces were measured by vertical storage capacity; bin and shelf capacity; and specialized stores capacity for products requiring vault, refrigerator, freezer, or hazardous materials (HAZMAT) storage. Warehouse throughput capacity was also estimated.

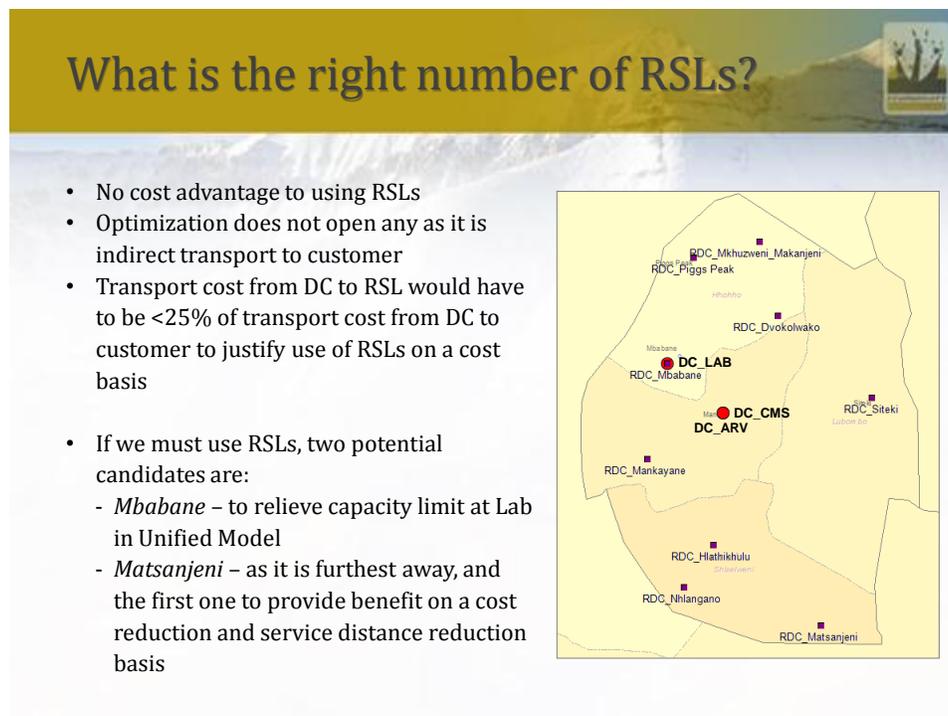
Standard weights and cubes for like items using a US Agency for International Development estimating tool have been applied to measure weight and cube of each of the 1,551 items in the system. Transportation costs for shipments within Swaziland were estimated by adjusting actual transportation costs from an earlier LLamaSoft project in South Africa and fitting them to Swaziland's geographic and road characteristics.

Supply Chain Simulation Findings

Once the SCG model was completely populated with valid data about Swaziland's customers, central stores locations and specialized storage capacity, products, transport capacity and limitations, and product usage, the model was run to find storage, distribution, and transportation optimization opportunities. As with the methodology section above, the results are more completely described in the Swaziland briefing attached as annex C.

Two major policy recommendations emerged from the analysis—

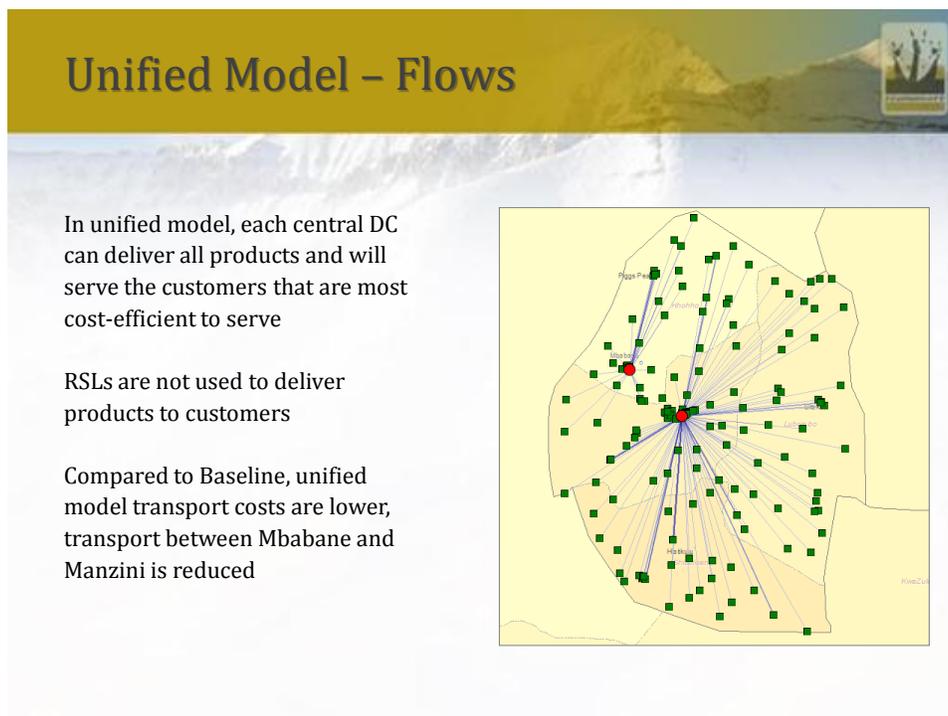
First, there does not appear to be a cost or performance reason to use any of the nine regional storage locations as satellite locations for the central stores facilities. In other words, the regional storage should continue to support the particular facility to which they are attached rather than expanding their role to support nearby outlying clinics. Swaziland is a small enough country that its central stores requirements can all be effectively supported from the three current central stores locations. Figure 2 depicts result of the SCG-derived storage facility cost analysis to support this recommendation.



Note: RSL = regional storage location.

Figure 2. SCG-derived cost analysis for regional storage locations

Second, the analysis shows that the three central stores locations (CMS in Matsapha, central laboratory stores in Mbabane, and ARV stores in Matsapha) can be more efficiently and effectively managed if the commodity types held by each can be cross-leveled across the three facilities. This type of approach, which the study termed the “Unified Model” approach, would leverage extra capacity in different central stores facilities at different times without overburdening any particular facility. It would be premature to terminate the leased facilities storing ARVs at this time, but facility consolidation may become an option once space use is optimized across the facilities as recommended. Before relocating any particular product from one central store location to another, consideration should be given to the storage requirements and likely demand frequency of that product, but as a general framework, the “Unified Model” could provide substantially better use of existing storage facilities.



Note: RSL = regional storage location.

Figure 3. “Unified Model” product flows and costs

Based on the Swaziland demand data input into SCG, the analysis showed a substantial amount of product movement between storage locations in Matsapha and storage and customer locations in Mbabane. This movement may add time, money, and customer wait time without any particular value added in the supply chain. As illustrated in figure 3, shifting to the “Unified Model” approach and storing some central stores items in Mbabane could eliminate a substantial amount of that traffic. That would have the added benefit of improving response times and overall customer support to the Piggs Peak region and other areas in the north and west of the country while lowering overall transport costs by as much as 18 percent. The staffing

implications of such changes are unclear at this point, but additional staff costs would be unlikely to outweigh benefits of this magnitude.

The SCG analysis did not include a study of inbound transportation routes, schedules, and costs, but the model suggests that substantial additional savings in storage space and inventory holding costs may be available through optimization of inbound transport. Swaziland is a small country with a well-developed road network close to Johannesburg, South Africa, and other population centers with sophisticated health commodity supply chains. Changes to recommended inventory holding, reorder, and shipping practices may permit substantial reductions in the amount of inventory held and managed at central and regional locations. The SCG model is easily extendible to enable this analysis in the near future.

Other SCG information is available in annex C. Not included but available is the raw data set assembled to build the complete simulation model.

CONCLUSIONS

Swaziland provides a unique opportunity to implement modern health commodity supply chain practices in an impoverished developing country with dramatic health challenges. The swift and effective response to those challenges has produced a fairly robust health commodity supply chain infrastructure, well-educated supply chain leadership, strong and well-supported information systems, and a sincere desire to improve. Additional near-term improvements in warehouse staff development and training, the application of information technology across the health commodity supply chain, and improved supply chain integration and governance are both possible and desirable.

Also in the governance area, continued development of the current TWG, which is expected to evolve into a true governance body as the Swaziland Medical Supply Chain BoD as the effort continues.

With regard to SOPs, the existing SOPs should be implemented at both central and facility levels across the country and for all medical commodity types, including laboratory supplies. The inclusion of a physical storage SOP as part of the existing SOPs will complete the initial set of SOPs needed to guide the establishment and operation of a modern health commodity supply chain for Swaziland.

Finally, the network optimization, distribution, and transportation optimization efforts represented in the SCG provide useful direction for future enhancement of those aspects of the Swaziland health commodity supply chain. The last several slides in the SCG presentation at annex C suggest possibilities for future work,

ANNEX A: SITES VISITED AND PERSONS CONTACTED

Name	Title	Organization/Affiliation
Dr. Steven V. Shongwe	Principal Secretary	Ministry of Health (MoH)
Dumisani Kunene	Technical Director	Swaziland National Emergency Response Council on HIV and AIDS (NERCHA)
Sikelela Dlamini	Under Secretary–Technical	MoH
Dr. Vusi Magagula	Deputy Director of Health Services	MoH, Health Services
Michael Dube	Financial Controller	Ministry of Health
Peter Ehrenkranz MD, MPH	Care and Treatment Team Lead / Acting CDC Country Director	PEPFAR Swaziland
Kidwell Matshotyana	Country Project Director	MSH/SIAPS
Gashaw Shiferaw	Senior Program Associate	MSH
Fortunate Fakudze	Senior Pharmacist	MoH/CMS
Tibuyile Sigudla	Procurement Pharmacist	CMS–ARV Warehouse
Celani Malaza	Procurement and Warehouse Manager	National Laboratory Warehouse
Steven Chambers	Senior Program Associate	MSH
Garrett Young	Program Manager: Access to Medicines	Clinton Health Access Initiative (CHAI)
Siphiwe Diamini	Senior Consultant	Price Waterhouse Coopers– Global Fund LFA
Francis Vilakati	Procurement Specialist	Procurement Unit: MOH
Norman Malinga	Hospital Pharmacist	Hlathikhulu Government Hospital
Farai Katsuanga	Pharmacy Technician	Nhlagano Health Centre

ANNEX B: STANDARD OPERATING PROCEDURES

CMS Standard Operating Procedures

CENTRAL MEDICAL STORES	
<i>Title: Swaziland Medical Supply Chain Distribution</i>	
SOP No:	No of pages: 3
Compiled by:	Approved by:

OBJECTIVE(S):

To define the procedure for collecting data relevant to the operations of the CMS distribution system.

To ensure that data collected is relevant to the distribution process and can be used to increase both efficiency and effectiveness.

RESPONSIBILITY

Accountant
Pharmacist
Pharmacy Technician
Pharmacist in Charge
Information Technology Personnel

RESOURCES

Strategic Plan
Distribution Concept and Plan (goals, objectives, metrics and customer delivery timeframes)

PROCEDURES

1. Distribution Concept

- The CMS will develop a distribution plan and make it available to all.
- The CMS will develop and maintain a current strategy and plan specific to distribution objectives, goals, and metrics, which will include timeframes for customer delivery?
- Distribution related performance metric/objectives will be developed and monitored.
- The Strategic Plan will provide guidance for developing a distribution strategy.

- The distribution plan will be developed with emphasis on detailed routing and zoning parameters.
- Current internal and external transport fleets will operate with established routes and driving time goals.
- CMS will develop a distribution plan that specifies distribution zones and primary routes.
- Distance driven and associated costs are identified as essential criteria in the determination of zones and routes.
- Senior management verifies all zones and routes to ensure best value for service.
- Contracts for outsourced transport support will specify expectations for security, care in transport and delivery time goals for medical material.
- The distribution-transportation contract and performance work statement will specify how costs for delivery and services will be determined and adjudicated.
- Does the current distribution strategy and plan include the requirement to incorporate medical material into mixed loads in order to distribute parallel commodities?
- Cold chain management of medical material will be mandated in the distribution strategy.
- The CMS will ensure that internal and external fleets will maintain both refrigerated and freezer capable vehicles.
- The CMS will develop an annual budget with sufficient funds to effectively manage and meet expectations for the distribution of medical material.
- CMS will ensure the function of distribution for the operation currently programmed and budgeted as a distinct accounting line.
- CMS will ensure current internal and external fleet distribution operations are in accordance with written policy, procedures and routinely audited.
- CMS will ensure mechanisms are in place to determine if the existing distribution strategy, plan and programmatic support improved in transit visibility (ITV) or radio frequency identification (RFID) technologies.

2. Distribution Operations

- The CMS staff will develop mechanisms to provide daily management control over both internal and external fleets?

- The CMS staff will ensure assigned transports maintained and in good operating condition.
- The CMS staff will ensure all drivers and assistant driver are licensed and included in training programs.
- The CMS will develop training programs to ensure drivers are trained and evaluated on their knowledge of proper security, care in transport and delivery time goals for medical material.
- A quality assurance monitoring program will ensure all refrigerated and freezer capable transports are checked for temperature hold before being loaded with medical material.
- Drivers will be required to maintain daily driving records and the CMS management will audit and maintain records.
- CMS will develop and maintain a record of any failed delivery of medical materiel to a customer destination(s).
- CMS will develop and maintain a record of any missing, damaged, expired or out-of-temperature-range medical material after delivery at customer destination.

CMS Standard Operating Procedures

CENTRAL MEDICAL STORES	
<i>Title: Swaziland Warehouse Operations</i>	
SOP No:	No of pages: 15
Compiled by:	Approved by:

OBJECTIVE(S):

To define processes, procedures and policies for the CMS to include physical security, personnel security, product security and daily operations.

RESPONSIBILITY

All

RESOURCES

Strategic Plan
Standard Operating Procedures
Warehouse Plano graph
Quality Assurance Policies and Procedures
Employee Training Guides

PROCEDURES

1. Utilities/Power Supply

- The facility should have sufficient amp load capability.
- The facility should have emergency backup power.
- The emergency power should be tested semi-annually and documented with copies obtained.
- The facility should be connected to all public utilities (telephone, water, sewer, gas, and electricity).
- The heating, air conditioning, gas, and electricity should operate properly.
- The facility should be environmentally controlled.
- The ventilation should be adequate and exhaust systems should be working.

- The facility should have Local Area Network (LAN) connection of high-speed internet capability.
- The facility should have adequate lighting.
- There are a sufficient number of battery recharge stations (outlets) for the material handling equipment and they are consolidated.

2. Physical Security

- The facility should have minimal threat targets/hazards within its vicinity.
- The facility should have minimal history or evidence of uncontrolled external access into the building.
- Access control should be visibly enforced.
- The facility should have a physical security plan and a copy will be obtained.
- The facility manager will conduct semi-annual key inventories.
- The facility will have emergency bomb procedures.
- The facility should have an occupant emergency evacuation plan.
- There should be exterior barriers extending the physical perimeter (i.e., concrete barriers, planters, boulders, fences, and vehicle gate controls) of the facility.
- The exterior barriers should be separating the parking/drop-off area from the facility.
- All exterior and interior doors should have two locks (i.e., one deadbolt and one key lock).
- Door hasp bolts should be installed on the interior of all door frames.
- All exterior doors should have high security locks.
- If the facility has more than one tenant, internal security barriers should be in place and inspected.
- The facility should have monitoring devices or intrusion detection systems (IDS) installed.
- If the facility has monitoring devices or intrusion detection systems, all access points such as exterior doors, windows, and loading dock doors should be alarmed.

- The IDS should be tested periodically and documented with a copy obtained.
- The IDS should be on backup power supply.
- The IDS should be tested semi-annually.
- There should be exterior lighting with 360-degree coverage around the exterior of the facility.
- There should be key and badge controls for perimeter doors.
- Access to utilities, such as heating, ventilating, air conditioning, backup generator, and utility closets should be limited to authorized personnel only.

3. Personnel Security

- Personnel should be subject to background checks.
- Personnel should have security identification badges.
- The facility should conduct annual physical security awareness training.

4. Receiving Area

- Material should be segregated and processed by Bill of Lading.
- Segregated material should be physically opened and inventoried using packing lists, purchase order, or my vendor call number.
- All material inventories should be documented using the two-man rule.
- Receipts should be immediately posted in the inventory management system using the two-man rule.
- If materials are for stock, storage locations and quantities should be posted in the inventory management system.
- If materials are for stock, storage locations should be printed or tagged to the exterior packaging.
- If not automated, receipted quantities should be documented on a receiving document and signed using a two-man rule.
- If not automated, storage locations, potency dates and lot numbers should be documented on the same receiving document.
- The expiration date, lot number, manufacturer number should be written on each copy of the purchase order.

- The expiration date, lot number, and manufacture number should be visually checked on each product and documented on the outside of each exterior box and inputted in the inventory management system receipt.
- Copies of all receipt documentation (i.e., Bill of Lading, pack list, purchase order, and/or vendor call number, and receiving document) should be stapled and kept in a “completed file.”
- The completed receipt documentation should be delivered directly to Procurement and/or Inventory Managers for obligation and status inputs.
- Once receipted, materials for stock should be moved away from the receiving area and staged for put away into storage locations.
- If materials are identified as “cross dock customer,” the materials should be moved into shipping once posting is completed.
- The receiving should have a process for resolving quantity discrepancies between the Bill of Lading and the quantity received and a copy should be obtained.
- Controlled substances should be segregated, received, and stored in a lockable container prior to transfer to the vault.
- The controlled substance container should also be sealed with tamper-evident seals in the receiving area using a two-man rule.
- Records kept in receiving on all tamper-evident seals should be applied in the receiving area.
- The controlled substance container should be transferred to the vault conducted by the controlled substance custodian and a receiving clerk.
- For material not processed because of missing receipt information, there should be a segregated space within the receiving area identified for “FRUSTRATED RECEIPTS.”
- Frustrated receipts should be posted in a separate file and worked daily with Procurement and/or Item Managers to attempt processing.
- Aged frustrated receipts should be reviewed by the Account Manager for appropriate resolution or action.
- On arrival, drivers’ credentials should be checked and logged into a “Drivers’ Log.”
- The receiving area/shipping area(s) should be monitored and secured.

- A waiting area with restrooms should be located in an area proximal to the area to prevent visitors and/or drivers from entering the receiving/shipping area.
- Materials should be adequately protected against pilferage.
- If items are received in cold or frozen pack containers, these should be taken on arrival to the refrigerator or freezer for inventory and receipt processing later in the day.
- Prior to placing in temperature controlled storage, the temperature of contents at receiving should be recorded on the receipt paperwork.
- The receiving area floor should be cleared and cleaned at the close of each business day.
- Written procedures should be in place to deal with any violations of packaging requirements of material received.
- On separate pages, describe and flowchart the existing receiving processes.

5. Storage Area

- The layout of the storage area should maximize the efficiency of storage and distribution of the product to customers.
- Warehouse staff should use bar-code technology to facilitate storing the product.
- Storage should have established performance standards, i.e., 24 hours for processing of cutaways into locations.
- Products should be stored properly to minimize damage.
- Employees should be trained to ensure the proper handling, storing, and distribution of the product.
- The warehouse should be organized using a floor diagram and a discrete location numbering system throughout.
- The floor diagram should be updated and available for reference by the warehouse staff.
- Locations should be kept current on the floor diagram.
- The storage locations should be adequately identified to facilitate the location of the product.
- Measures should be in place to prevent unauthorized access to the storage area.

- Fast, medium, and slow-moving products should be identified and located to ensure efficient handling, selection, and issue.
- Storage utilization should be monitored and action taken to prevent wasted or excess space.
- There should be sufficient space between storage racks to enable effective and safe access and use of material handling equipment.
- Results of the most recent location survey should be posted and in view by all staff.
- Shelf-life material should be stored by lot number and expiration date.
- The first-in first-out (FIFO) principle should be applied when storing and selecting shelf-life material.
- There should be a minimum 10 percent inventory conducted monthly, and a 100 percent warehouse-wide inventory conducted annually and a copy obtained.
- All aisles provide appropriate foot passage and all pallet risers should be installed with a safety locking device and distance documented.
- Fire evacuation plans should be posted through the warehouse facility and evacuation exercises should be conducted and documented quarterly. Obtain a copy of last evacuation exercise results.
- All warehouse staff receiving periodic drivers should be trained for all equipment (i.e., pallet jacks, material handling equipment, fire extinguishers) and first aid, at least annually. Obtain copy.
- All warehouse staff should possess a current valid operator's license for all required equipment and vehicles. Visually confirm.
- All warehouse staff should wear/use lumbar supports, safety visors/glasses, aprons, safety shoes, and Material Handler safety harnesses.
- The warehouse should be cleaned, free from infestation, accumulated waste, and row maintenance should be performed regularly.
- All materials should be received and properly stored into locations, daily.
- Material requests should be pulled and staged for shipment using a pick list.
- Pick lists should be initialed by the puller and secured with the picked material.
- Warehouse staff should perform cycle counts when a warehouse denial occurs.

- There should be an established process for performing cycle counts and resolving warehouse denials. Obtain a copy.
- Location errors should be resolved or reported/documentated to the warehouse manager as they occur.
- Material location changes should be recorded in the inventory management system.
- There should be an established process for processing excess, expired, and unserviceable products. Obtain a copy.
- There should be a contract to properly dispose of expired material.
- There should be an established process for recall of product. Obtain a copy.
- Recalled product should be quarantined until proper disposition instructions are given.
- There should be an established process for processing customer returns. Obtain a copy.
- There should be a contract to properly dispose of expired, unserviceable, and hazardous materials (HAZMAT) products.
- There should be a comprehensive product surveillance program to ensure the serviceability and reliability of material.
- Shelf-life material and other material with deteriorative properties should be stored in environmentally controlled areas.
- Unserviceable material should be segregated from usable stock and placed in a quarantined area.
- The storage activity should have the appropriate material handling equipment to ensure efficient operations.
- The storage area should have sufficient lighting to enable operations to be executed accurately and safely.
- The warehouse operation should have a product rotation program for shelf-life material established with commercial vendors.
- On separate pages, describe and flowchart the existing storage processes.

6. Hazardous Material (HAZMAT)

- HAZMAT locations should be included in the warehouse floor diagram.

- There should be a monthly inventory of all HAZMAT. Obtain copy of last inventory.
- The HAZMAT storage area should be separated from the rest of the warehouse storage locations.
- The HAZMAT should be stored separately by hazard type.
- Manufacturers' Material Safety Data Sheets (MSDS) should be kept up to date and available for use by all warehouse staff.
- HAZMAT placards for each type should be posted on internal storage area doors, and on the warehouse exterior doors designating the highest danger.
- Discrepancies with HAZMAT should be immediately investigated, reported, and documented.
- There should be a wash station near the HAZMAT storage area. It should work and be regularly inspected to ensure proper operation. There should be documentation of the testing.
- There should be portable wash stations installed in the receiving, shipping, and warehouse. They should work and be regularly inspected to ensure proper operation. There should be documentation of the testing.
- On separate pages, describe and flowchart the existing HAZMAT processes.

7. Controlled Substance Storage Area

- Materials should be immediately processed into the area with controlled substance custodian and receiving clerk.
- Each item should be immediately posted to the vault master record using a two-man rule.
- Each item's expiration date, lot number, and manufacture number should be posted in the master record and purchase order.
- Controlled substances should be shelved by expiration date using FIFO.
- Issues should be strictly processed with pick lists with quantity and initials posted in the controlled substance master record.
- Issues should be repackaged and prepared for shipment in the controlled substance area.
- Outgoing shipments of controlled substances should be sealed with tamper-evident seals prior to leaving the vault.

- The controlled substance custodian should maintain a record of all tamper-evident seals.
- Controlled substances should be moved to the shipment area by the custodian, using a two-man rule.
- Controlled substances should be identified as Schedule I and II stored in an approved safe or vault.
- Double-high security locks should be used to secure door to the controlled substance area and vault.
- The vault should have a monitoring alarm system.
- The alarm should be periodically tested to ensure serviceability and are records maintained of the test results.
- Monthly inventories should be performed using a disinterested person.
- Inventory discrepancies should be properly investigated, researched, and documented.
- Management should be informed immediately of any inventory discrepancy.
- Access to the vault should be controlled.
- There should be an access roster posted on the outside of the vault door. It should be current.
- On separate pages, describe and flowchart the existing controlled substance processes.

8. Shipping Area

- Picked materials should be delivered to shipping with an initialed pick list.
- Materials orders should be organized for shipment preparation by customer.
- Material orders should be packed to prevent damage, breakage, spillage, or contamination by other products.
- Temperature-sensitive products should be packaged properly to prevent damage during transport.
- The shipping operation should use internal transportation or commercial assets, or a combination thereof, to transport product.

- Shipping personnel should verify the accuracy of the product picked to the pick list before loading on trucks.
- The shipping area should be adequate to handling the peak levels of volume.
- Transportation should ensure that the pick list and the Bill of Lading information match.
- Transportation should provide the carrier with a Bill of Lading to schedule transportation assets.
- The types of transportation modes (i.e., air, ground) that the organization uses should be described in comments block.
- Shipping personnel should stage material according to customer or destination.
- HAZMAT materials and orders should be segregated for shipment preparation by customer.
- All HAZMAT material orders should arrive for shipment with the respective MSDS.
- Controlled substances should arrive in shipping in a locked container with tamper-evident seals.
- Material orders should be checked and documented on a packing list by customer.
- The packing list should be used to build the Bill of Lading for shipment.
- Prior to order assembly, each material order should be signed, with customer copy left with material.
- The order assembly process-thru-to banding should be conducted using a two-man rule.
- During order assembly and shipment preparation, all customer materials should be boxed with packing materials, consolidated material release orders, and MSDS sheets, as appropriate.
- Prepared shipping labels and packing slips should be affixed to the outside of all shipment containers.
- The shipment containers should be marked as “MEDICAL” and “TEMPERATURE CONTROLLED,” as necessary.
- Each customer shipment container should be banded with a tamper-evident seal prior to transport arrival, or before the end of shift.

- Each shipment container's weight and cube should be documented on the Bill of Lading.
- Bill of Lading documents should be kept with each shipment until transport arrives.
- Material orders for controlled substances and HAZMAT should be processed separately, at designated times.
- On arrival, driver's credentials should be checked and logged into a "Drivers Log."
- Once transport arrives, the shipment clerk should work with the transport driver to confirm shipments, special load instructions, and complete signatures on Bill of Lading.
- Once shipment has departed, the shipping clerk should assemble one copy of all documentation, post release, and shipment in system before filing.
- If manual, the shipping clerk should assemble remaining copies of all shipment documentation and deliver to the Item Manager for ledger posting.
- On separate pages, describe and flowchart the existing shipping processes.

9. Refrigerated Items

- Receipted refrigerated items should be immediately transferred to storage personnel for put away.
- Refrigerated items should be maintained at recommended temperatures.
- The refrigeration units should have temperature-monitoring devices to ensure proper temperature ranges are maintained.
- Storage personnel should periodically check the temperature of these units to ensure that temperature ranges have not exceeded recommended manufacturer ranges.
- A daily log of temperature should be maintained.
- The log should be posted outside the refrigeration unit.
- The refrigeration units should have an alarm system that alerts storage personnel if the unit malfunctions.
- If so, the alarm unit should provide alerts to storage personnel if the unit fails after normal duty hours.

- The refrigeration units should be on emergency power.
- Storage should have procedures for the proper handling, storing, issuing, and transporting of refrigerated material.
- Warehouse personnel should be properly trained in the handling of refrigerated items.
- The storage operation should have a written emergency plan of action in the event of a power outage.
- The storage operation should have a contract with a refrigeration repair company to respond to equipment malfunctions.
- Storage personnel should be familiar with the plan and what actions to take.
- Food, water, or beverages should not be stored in these units.
- If spoilage occurs, refrigerated items should be segregated from the regular inventory.
- Storage personnel should immediately notify Quality Control Unit (QCU) if spoilage occurs.
- Refrigerated items should be packed in approved containers prior to shipment.
- For vaccines, insulated containers should be used and temperature monitors should be placed in the container to monitor the temperature while in transit.
- Vaccines should be stored away from walls, coils, and peripheral areas.
- There should be procedures that prohibit vaccines from being stored in the refrigeration unit door.
- Access should be limited to the refrigeration units to authorized personnel only.
- Upon receipt, receiving personnel should know to notify the supervisor and QCU if the temperature monitor inside a vaccine container indicates the temperature ranges have been exceeded.
- On separate pages, describe and flowchart the existing refrigerated item processes.

10. Quality Assurance/Quality Control (QA/QC)

- The organization should have a Quality Control Unit (QCU) that is responsible for Quality Assurance/Quality Control (QA/QC) and ensure that government regulatory requirements are being met or enforced.

- There should be an approved quality assurance management plan that delineates the quality assurance program for the organization. Obtain a copy.
- The plan should contain management's quality policy and objectives.
- The plan should be implemented and followed.
- QA/QC employees should have read and signed the plan.
- QA/QC practices, methods, and techniques should be applied and enforced.
- QCU should have a quality improvement process.
- QCU should conduct quality reviews with management and employees.
- QCU should have a Corrective Action/Preventive Action (CAPA) system to identify, correct, and prevent quality deficiencies and non-conformances.
- A CAPA request number should be assigned to each quality problem found.
- Management should review all CAPA problems.
- The QCU should have a document management system that establishes guidelines for the reviewing, revising, approving, and version control of documents. Obtain a copy.
- The QCU should have a records management system that establishes guidelines for maintaining and disposing of quality records. Obtain a copy.
- The organization should be subject to government regulatory requirements pertaining to the management, receipt, storing, and distribution of pharmaceuticals.
- The QCU should have a quality training program. Obtain a copy.
- The QCU should have procedures for creating, revising, and disposing of documents.
- The QCU should perform system transaction audits to verify the accuracy of data input into the inventory management system.
- The QCU should have an audit program.
- The QCU should have a process to verify established performance standards or metrics such as inventory and locator accuracy, receipt processing time, order accuracy, and pick list processing time.

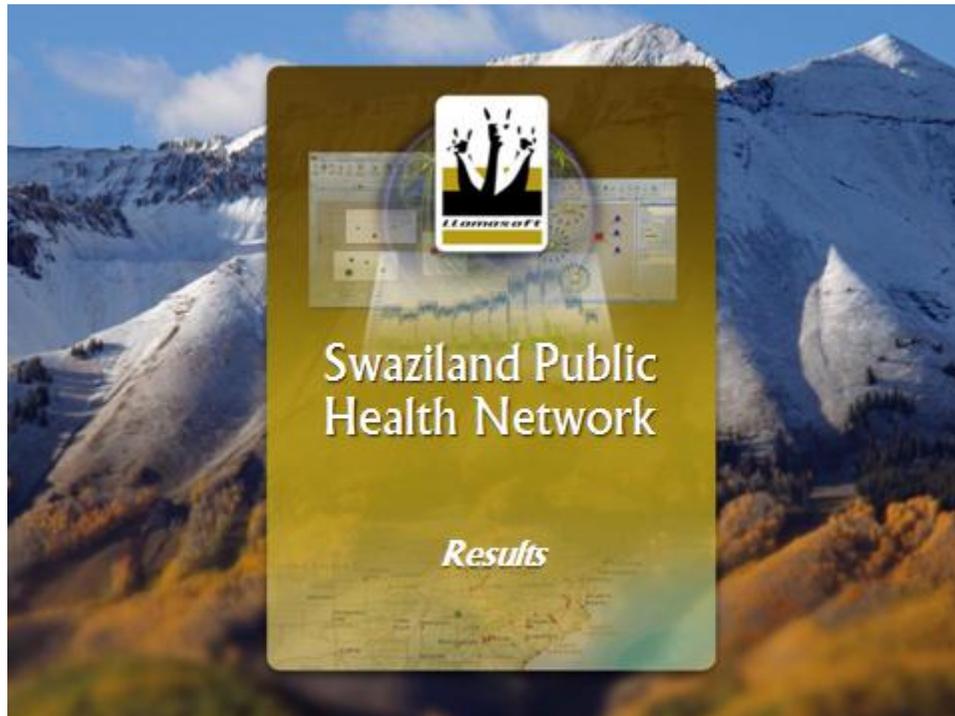
- The QCU staff should perform quality checks, i.e., verification of lot number, expiration date, correct quantity, and correct product pulled, of product that is selected for issue.
- On separate pages, describe and flowchart the existing QA/QC processes.

11. Inventory Management (IM)

- Organization should use an automated IM system to manage and process material orders. Specify the system(s).
- The IM system should be robust enough to manage all existing functions of the operation (i.e. order management, quality control, receiving, storage, and shipping).
- If manual, procedures with internal controls should be evident and robust enough to manage all existing functions of the operation (i.e., order management, quality control, receiving, storage, and shipping).
- The IM system should have the ability to track inventory value and costs.
- There should be a formal organization Inventory account and master item file.
- The IM section should establish minimum and maximum levels in the IM system for each master record file item.
- Reorder points should be established for each master record file item
- The IM system should be used for batch picking.
- The IM system should produce standard management reports for reviewing the inventory posture.
- The IM section should have an automated process for customer's to order material.
- The IM section should have a process for providing automated material status to customers.
- The IM section should use "fill or kill" when processing customer orders.
- The IM section and director should utilize key performance indicators to evaluate the effectiveness and efficiency of its overall operation. Obtain a copy of current KPI report (s).
- The IM section should have a customer support element and a support handbook distributed to each customer.

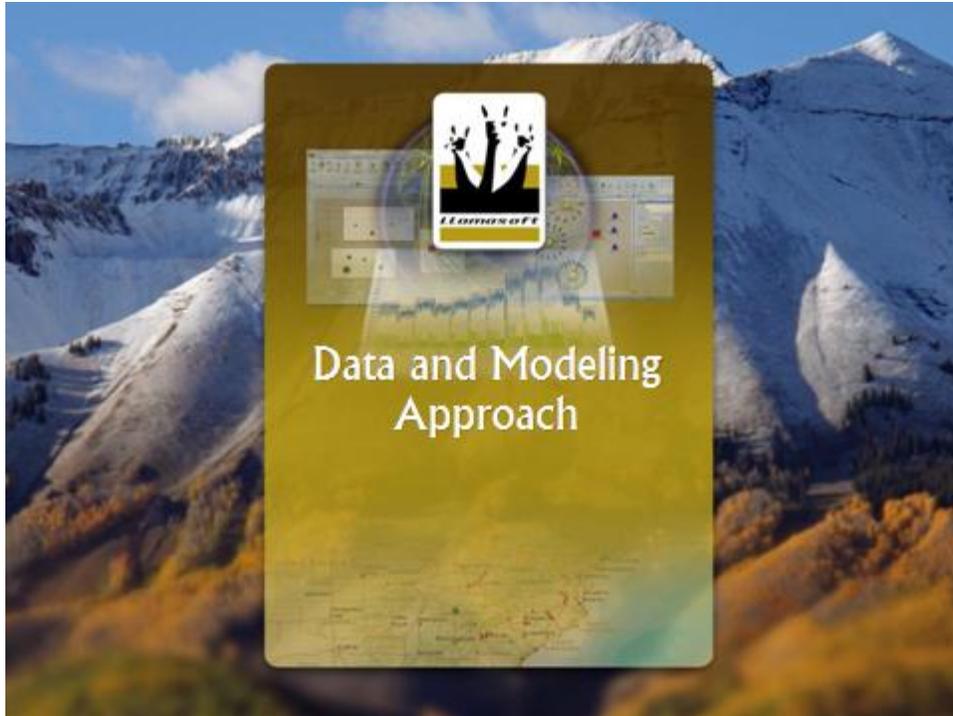
- The IM section should have the appropriate staff level and skill mix to effectively perform its support mission to the customer base.
- The IM section and director should establish and conduct an employee training program. Obtain a copy.
- There should be a record of the current year 100 percent wall-to-wall inventory.
- In addition to the annual wall-to-wall inventory, there should be a record of cyclic inventories.
- The record copies of Inventory Adjustments with associated research should be for cause.
- The IM section should periodically evaluate the status of the inventory for obsolete or slow-moving material.

ANNEX C: SUPPLY CHAIN GURU PRESENTATION



Agenda

- Data & Modeling Approach
- Analysis & Results
 - Baseline
 - Unified Model
 - Use of Regional Storage Locations
- Conclusions
- Potential Further Analysis



Products

- Products aggregated to 3 groups (ARV, CMS, Lab) for model manageability
- Product names matched to USAID product list using fuzzy string matching with LLamasoft tool - weights and volumes taken from match
- Unmatched product weights and volumes filled in as average of matched product groups or close substitute product
- For each product group, weight and cube calculated as weighted (by quantity) average of all products in its class
- Result
 - ARV: Weight 0.14 kg, Cubic 0.47 liter
 - LAB: Weight 1.24 kg, Cubic 4.33 liter
 - CMS: Weight 0.69 kg, Cubic 2.3 liter

Source	Source Date	Source Product Number	Product Name / Description	Units of Measure		Volume		Weight		
				Quantity	UOM	MatGrp Desc.	Volume	Vol. unit	Gr. Wgt.	Wgt. Unit
UNICEF	2008	S0003656	3TC 30mg+NVP 50mg+d4T 6mg ds tab/P-60	see product name	EA	Antiretrovirals	0	CDM	0	KG
UNICEF	2008	S0003687	3TC60mg+NVP100mg+d4T12mg ds tab/P-60	see product name	EA	Antiretrovirals	0	CDM	0	KG
IDA	2008	302801	5-Fluorouracil 250mg/5ml, for injection	1	vial		86	CCM	0.02	KG
MissionPha	2008	F0679	Abacavir 100mg/5ml, 240ml, syrup	1	bottle		0.00074	M3	0.35	KG
MissionPha	2008	AA386	Abacavir 300mg	60	tablets		0.00034	M3	0.1	KG
UNICEF	2008	S0003600	Abacavir 300mg tabs/PAC-60	see product name	EA	Antiretrovirals	1.63	CDM	0.075	KG

Sites

- Customer sites from Demand Table matched to Geocoded sites list using LLamasoft tool
- Matching refined manually and updated to reflect correct city locations
- DCs and RDCs located at provided (manually matched) city
- Result:
 - Number of Customer Sites: 171
 - Number of DCs: 3, Number of RDCs: 9

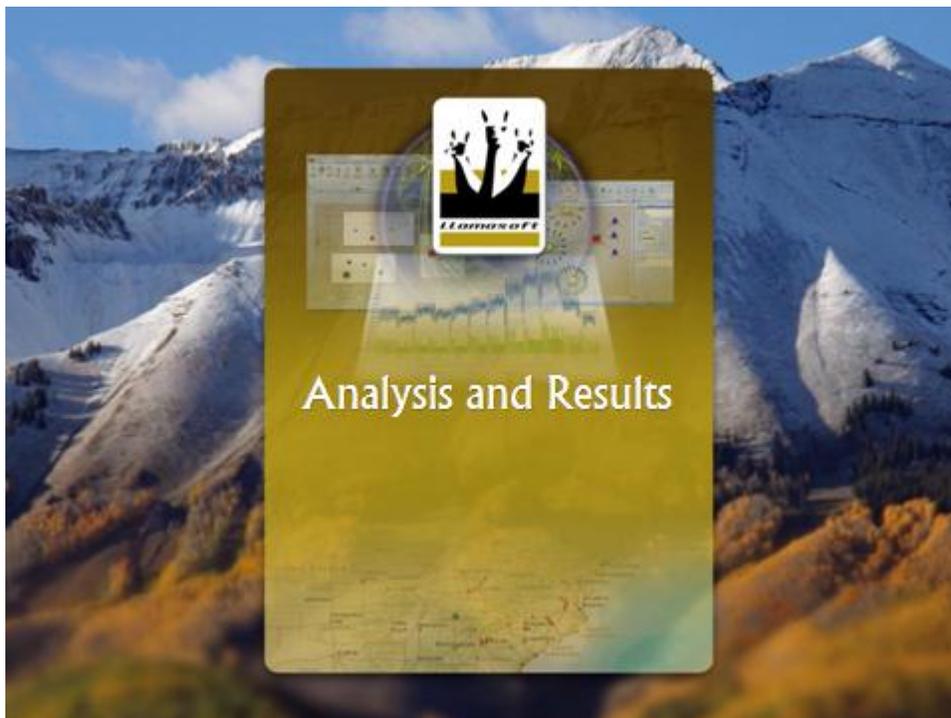
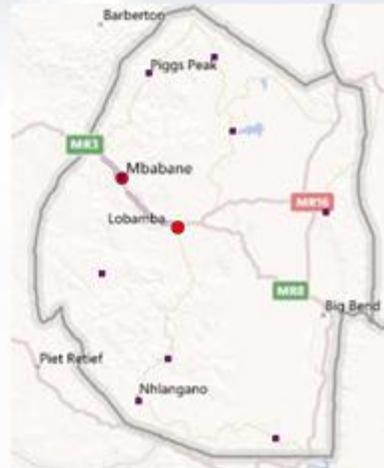
Customer Site	Best Match Geocoded Sites	Best Match Score	Latitude	Longitude
Nhlangano Health Center	Nhlangano health centre	0.83	-27.1211	31.20791
Nhlelsheni Clinic	Nhlelsheni clinic	0.82	-27.043	31.39524
St Theresa Clinic	St Theresa's clinic	0.82	-26.50345	31.38013
St Philips Clinic	St Philip's clinic	0.82	-26.85402	31.76907
Kamfishane Clinic	Ka Mfishane clinic	0.82	-26.83776	31.41072
Phunga Nazarene Clinic	Ka Phunga Nazarene clinic	MAN	-26.74791	31.52088
Gege Clinic	Gege clinic	0.82	-26.96817	31.01637
Sigcaweni Clinic	Sigcaweni Nazarene clinic	MAN	-26.54036	31.72684
KA Phunga Clinic	Ka Phunga clinic	0.81	-26.79685	31.48288

Site Capacities

Site	Site M3 Capacity	Yearly throughput capacity 3-month 1mv holding	Yearly throughput capacity 7-month 1mv holding	Yearly throughput capacity 4-month 1mv holding	Basis for Static Capacity Calculation
DC_ARV	1008	4032	1728	3024	336 locations with 3m3 of storage each. Note ONLY 408m3 is Temp. Control
DC_CMS	1947	7788	3338	5841	1947 sq-m, with average ceiling height 2m, 50% of total room space can be filled with storage
DC_LAB	290	1160	497	870	120 locations with 0.75m3 of space + (40 sq-m with ceiling height 2.5m) + 150 m3 of pallet storage
RDC_Drokohwako	105	420	180	315	140 locations with 0.75m3 of space
RDC_Hlathikhulu	90	360	154	270	120 locations with 0.75m3 of space
RDC_Mankayana	90	360	154	270	120 locations with 0.75m3 of space
RDC_Matsanteni	90	360	154	270	120 locations with 0.75m3 of space
RDC_Mbabane	195	780	334	585	260 locations with 0.75m3 of space
RDC_Mkhuzweni_Makaneni	90	360	154	270	120 locations with 0.75m3 of space
RDC_Nhlangano	75	300	129	225	100 locations with 0.75m3 of space
RDC_Piggs Peak	105	420	180	315	140 locations with 0.75m3 of space
RDC_Siteki	210	840	360	630	280 locations with 0.75m3 of space

Transport (Roads)

- Road distances calculated using Bing
- Verified using publicly available GIS data



Existing Facilities

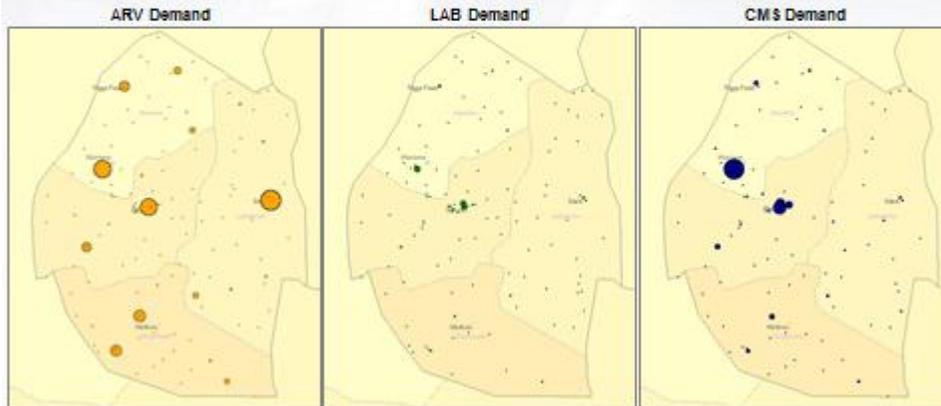
3 central DCs:
ARV, CMS in Manzini
LAB in Mbabane

9 regional storage locations (RSLs) in cities
across Swaziland



Demand

Demand for each product group has its own geographic pattern
Manzini and Mbabane main centers of demand



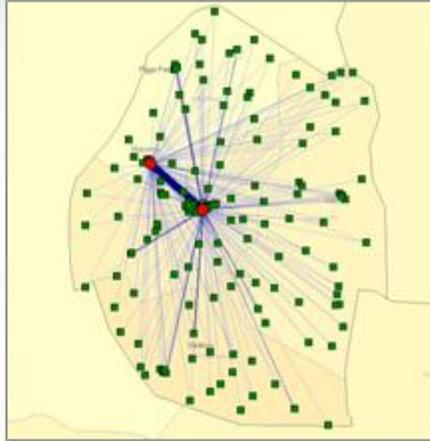
Customers scaled by cubic demanded note that scales are for visual representation & comparison not strict mathematical calculation

Baseline - Flows

In baseline, central DCs are restricted to provide only one product group each i.e. CMS facility delivers only CMS products to the entire country.

RSLs are not used to deliver products to customers

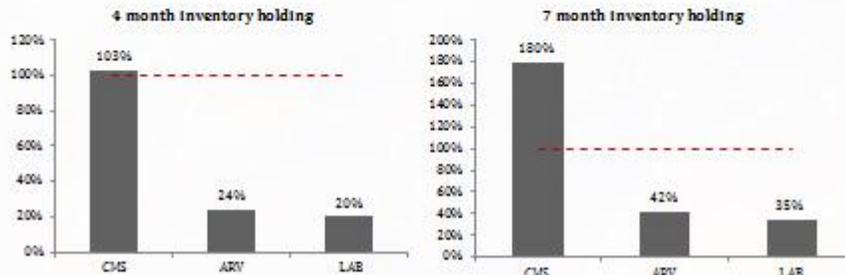
Estimated dollar value for annual transport costs in this model will be used as baseline value: 100



Flows scaled by cubic volume

Baseline – Capacity Utilization

- Policy is to hold 4-7 months of inventory at central DCs
 - Using available data on product weight and cube and on site capacities, utilization can be calculated for each facility
 - In baseline, central DCs show widely varying utilization
 - CMS utilization at >100%
 - ARV and Lab are at 20-42% utilization
- Inefficient allocation of space by restricting central DCs to one product group



Capacity Utilization

Utilization calculated differs from facility utilization observed on LMI Swaziland trip

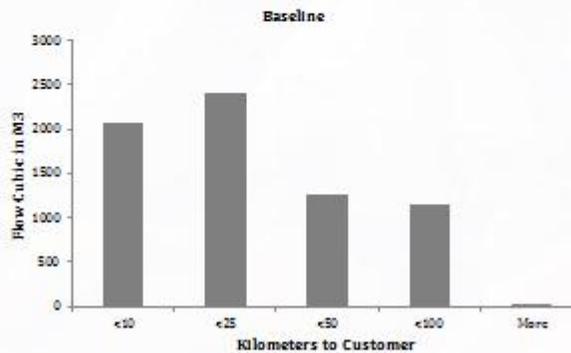
Potential explanations for discrepancy:

- Demand volumes could be substantially different from volumes ordered and stored at central facilities
- Product cube estimation could be incorrect
- Facility utilization snapshot observed during LMI Swaziland trip may be different from utilization throughout the year
- Facilities may each hold different levels of inventory (e.g. ARV may hold 7 months, but CMS may hold 4 months) at one time

Baseline – Service Distance to Customers

Almost all demand in SZ is within 100km of central DCs, so easily within a day's drive, with return trip

30% of customer demand (by cube) is within 10km of central DCs

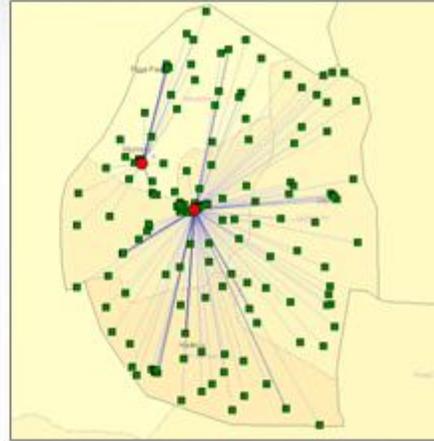


Unified Model – Flows

In unified model, each central DC can deliver all products and will serve the customers that are most cost-efficient to serve

RSLs are not used to deliver products to customers

Compared to Baseline, unified model transport costs are lower, transport between Mbabane and Manzini is reduced



Unified Model – Capacity Utilization

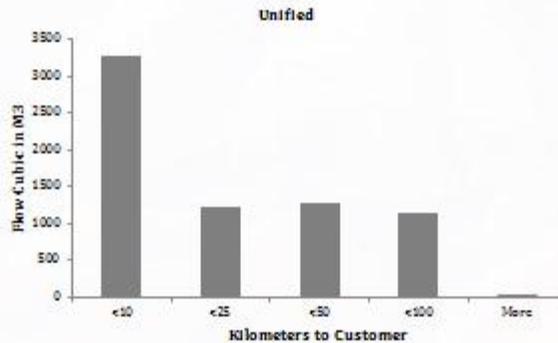
- In unified model, there is less variation in utilization levels across 3 central DCs as each DC can serve demand for all products
- For 7-month inventory holding policy, there is insufficient capacity to serve demand in the network
- For 4-month inventory holding policy, demand can be fulfilled



Unified Model – Service Distance to Customers

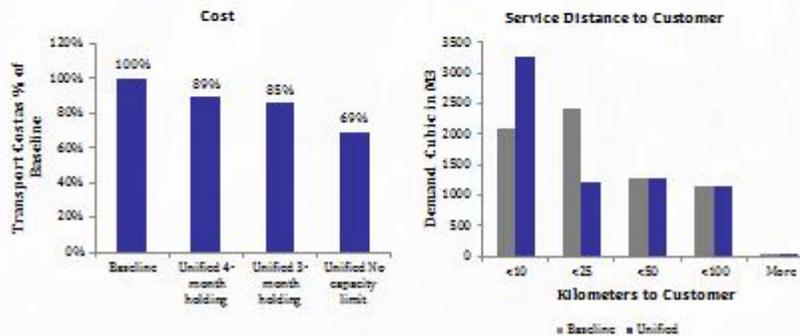
Almost all demand in SZ is within 100km of central DCs, so easily within a day's drive, with return trip

47% of customer demand (by cube) is within 10km of central DCs



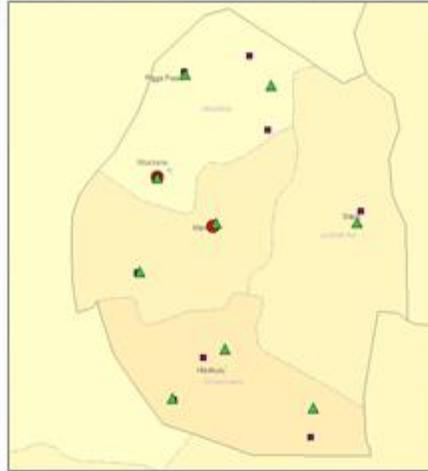
Comparing Baseline and Unified – Costs and Service Time

- Unified model costs less than Baseline because of lower transport costs; as each customer can be served by closest DC, unnecessary product moves are reduced
- Unified model also improves service distance by serving customer demand from closest available facility
- Important to note effect of inbound-to-DC; if all goods at Mbabane DC must come from Manzini, then cost savings on outbound leg are neutralized



Using RSLs - Greenfield Analysis

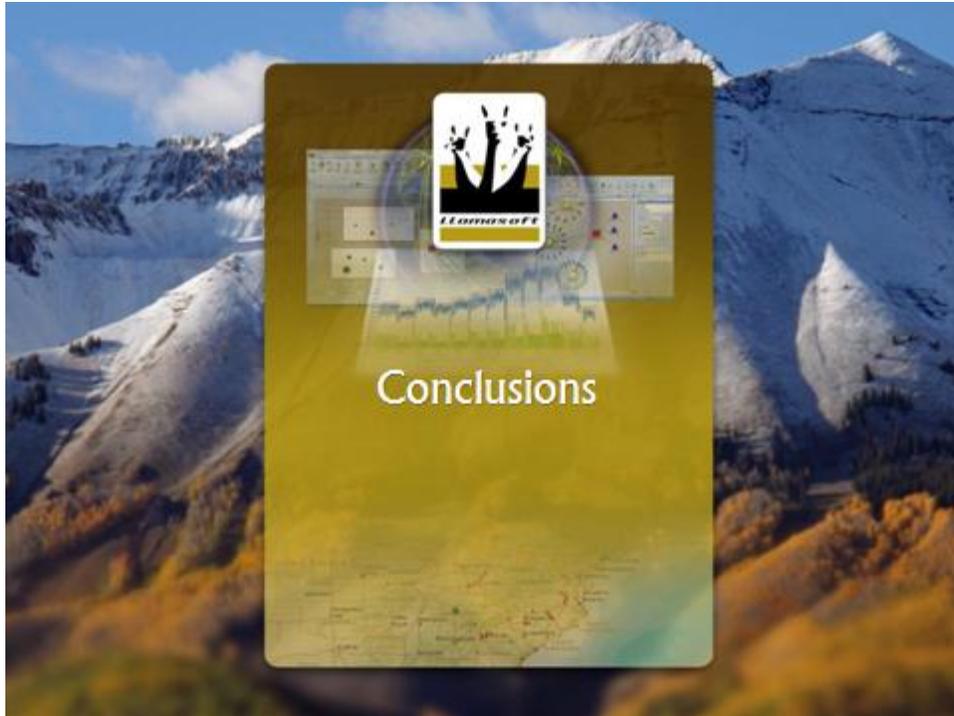
Greenfield analysis provides initial indication that the 9 potential RSLs are located in approximately the right regions of the country



What is the right number of RSLs?

- No cost advantage to using RSLs
- Optimization does not open any as it is indirect transport to customer
- Transport cost from DC to RSL would have to be <25% of transport cost from DC to customer to justify use of RSLs on a cost basis
- If we must use RSLs, two potential candidates are:
 - Mbabane - to relieve capacity limit at Lab in Unified Model
 - Matsanjeni - as it is furthest away, and the first one to provide benefit on a cost reduction and service distance reduction basis

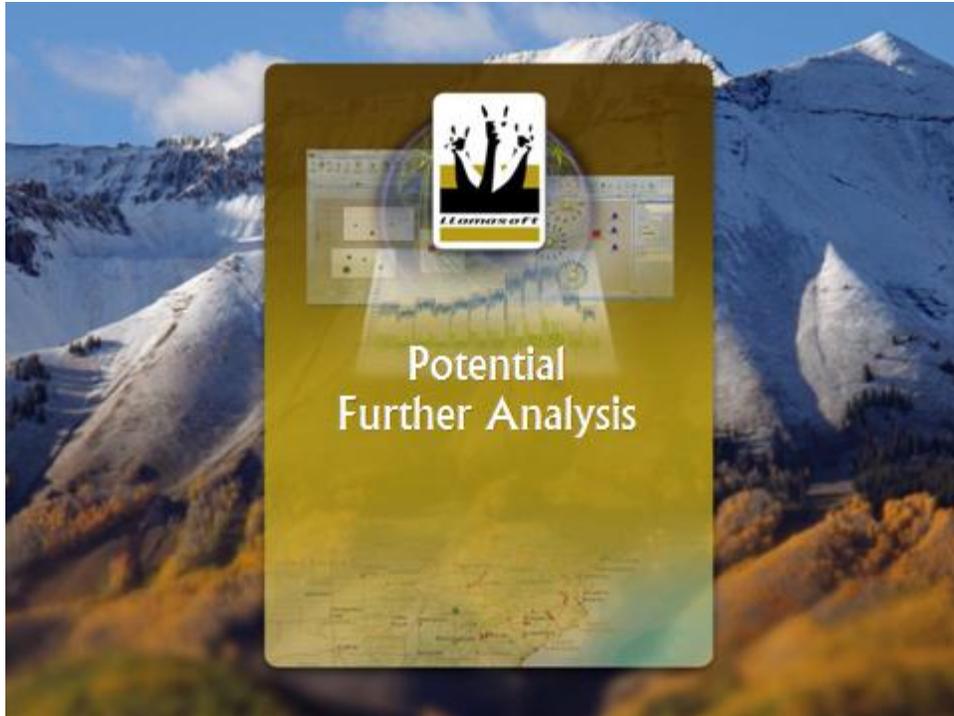




Conclusions

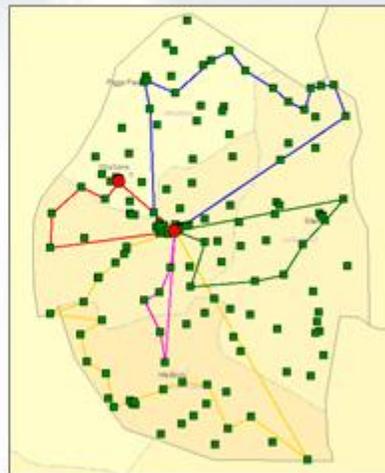
- Recommendation is to use the Unified Model as it is better on Cost, Service Distance, and Capacity Utilization (more uniform)
- It has a downside of adding more complexity in DC operations (more product groups, different storage requirements, less inventory transparency)
- However, benefits outweigh costs

	Cost	Service Distance	Capacity Utilization	Simplicity	Risk Mitigation	Score
Criteria Weight	5	3	3	2	1	
Baseline	2	2	2	2	2	28
✓ Unified	3	3	3	1	2	37
Unified + RSLs	2	3	3	1	3	33



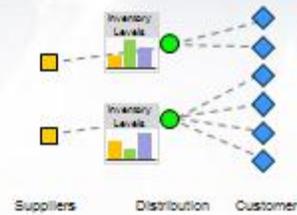
Delivery Route Planning

- Delivery routes can be planned for the transport of products from DCs to Customers
- Delivery routes will provide more granular and accurate basis for transportation cost calculation
- Delivery Routes can take into consideration available transport assets, periodic replenishments, driving time limits for a route etc.



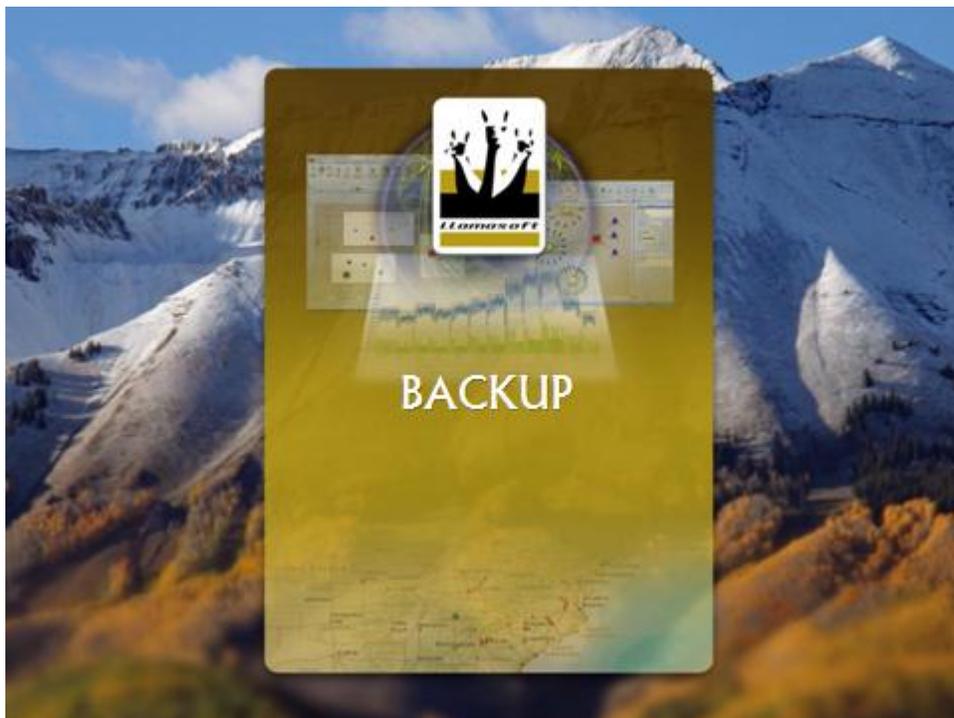
Inventory Analysis

- More detailed calculation can be undertaken to understand exactly how much inventory is needed (i.e. level of safety stock) by product
- Using variation in demand by product and customer group, the necessary inventory holding in months to provide a desired service level can be calculated
- Inventory policies including order quantities, order frequencies, reorder points etc. can be designed



Inbound to DCs

- Significant value can be added by considering the flows inbound to DCs
- Overall cost benefits can be calculated to minimize both inbound and outbound costs
- Supply variability also plays a role in determining necessary inventory



Costs

Regional benchmarks from past projects are used for transport cost and warehousing cost assumptions

Transport Cost

- USD 0.014 per liter-km

Warehouse Costs

- Central DCs - \$100k-\$300k per year

- RSLs - \$50k per year

7-month inv. holding: Demand not served

- In both the Baseline and Unified models; with 7-month inventory holding policy, there is not sufficient capacity to satisfy demand
- Significant portion of demand cannot be fulfilled
- If the DCs only fulfilled the optimal demand, the demand that would not be served is highlighted here

Scenario	Source	Cubic	Quantity
Unified	DC_ARV	25%	22%
	DC_CMS	48%	40%
	DC_LAB	7%	25%
	UNSERVED	20%	13%
Unified Total		100%	100%
Baseline	DC_ARV	10%	36%
	DC_CMS	48%	35%
	DC_LAB	2%	1%
	UNSERVED	39%	28%
Baseline Total		100%	100%

