KEMSA Support Program

Strategic Network Optimization Report

May 2013

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Kenya Medical Supplies Agency (KEMSA) Support Program

Contract Number: AID-623-C-11-00010

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ACRONYMS

ARV	Antiretroviral
CDC	Centralized Distribution Center
DC	Distribution Center
EMMS	Essential Medicines and Medical Supplies
ERP	Enterprise Resource Planning
GPS	Global Positioning System
KEMSA	Kenya Medical Supplies Agency/Authority
RDC	Rationalized Distribution Center
RHF	Rural Health Facility
SKU	Stock-keeping Unit
SOP	Standard Operating Procedure
SNO	Strategic Network Optimization
QA	Quality Assurance

EXECUTIVE SUMMARY

The Kenya Medical Supplies Authority (KEMSA) is a specialized medical logistics service provider with the core mandate to procure, warehouse and distribute medical commodities to the public sector. KEMSA also provides a secure source of drugs and other medical supplies to public health institutions and advises the Health Management Boards and the public on matters relating to the procurement, cost effectiveness and rational use of drugs and other medical supplies. The implementation of the KEMSA Act in 2013 transitioned KEMSA from an Agency to an Authority.

KEMSA recognizes that in the coming years, it will face many external and environmental changes that require a response in terms of the service delivery strategy and their logistics network configuration. The logistics network configuration refers to the number, size and location of distribution centers (DCs); the location of delivery points; the volume that they need delivered; the type of establishment that is delivered to; the products that are delivered; and the type of vehicles that are required to perform the deliveries. KEMSA currently has one central DC that delivers medical supplies to public health facilities which includes hospitals and rural health facilities (RHFs). KEMSA outsources delivery (transportation) to third party logistics providers who mainly use 10-ton vehicles.

Although many legal, organizational, operational and financial aspects need to be addressed, this document focuses on the logistics network configuration of KEMSA that would best support its ability to serve public health facilities in the future. This logistics network configuration review is a Strategic Network Optimization (SNO) analysis and focuses on projected changes at a strategic level. The results and findings are documented in this report.

The aim of the SNO analysis is to advise KEMSA on a logistics network configuration that best suites the Kenyan environment and optimizes cost and service levels based on projected future demand. With Kenya moving towards devolution in terms of governance, it is likely that the new county structure will place new demands on KEMSA to move away from an exclusive centralized approach. In addition, the future commercialization of KEMSA (as currently enabled through the Supplementary Services Division), will require increased service delivery and customer service flexibility to effectively compete in the market. For KEMSA the following future state scenarios were identified as critical:

a) **Scenario 1: Centralized Distribution**
   This scenario reviews the current centralization model against potential projected future volumes for 2017 and 2030 to determine cost impacts and required warehouse sizes for a centralized model. We compared this model against decentralization alternatives.

b) Scenario 2: DC in Every County
   This scenario reviews the cost impact of establishing a DC in all the 47 counties. The rationale here is to understand the cost impact of potential requests for county specific DCs.

c) **Scenario 3 and 4: Optimal DC Locations leading to Rationalized Distribution Center (RDC) Locations**
   This scenario reviews the placement of DCs across the country based on demand volume from the facilities and best cost, as well as best service comparisons and future growth and geographical considerations.

Following the current state assessment, we developed simulations of current and future state scenarios using CAST, a supply chain network design software, to develop these models. Global Positioning System (GPS) coordinates of facilities, depots and warehouses as well as the Kenyan road network were used to represent a virtual logistics network. Transport costs, demand volumes and other key operational parameters such as truck sizes and travelling speeds were defined as inputs.

We compared the various scenarios in terms of cost impact and service levels. The findings and recommendations are presented below.

- **Three DC Scenario:** Positioning the three DCs in Nairobi, Kisumu and Mombasa provided the optimal configuration. By 2017, this will result in a potential 2.1% (KES 24 million) reduction in annual operating costs when compared to the centralized distribution strategy. Since the three DCs are located in and close to high demand areas, it would also improve responsiveness of the logistics network, resulting to improved customer service levels. Currently, using the Nairobi DC, KEMSA delivers 39% of the volume within four hours to the health facilities. Using the three DC scenario, 84% of volume would be delivered within four hours, thus improving customer service levels at a slightly lower cost.
- **Mombasa and Nyeri Depots:** Upgrading the Mombasa depot infrastructure may present challenges due to current land and structure limitations. The alternative would be Nyeri depot. Nyeri depot requires less infrastructure investment. It aligns with the rollout plan and delivers almost a similar volume within 4 hours.
- **DC in Every County:** Establishing a DC in the largest town of every county would be 60% more expensive than using a centralized distribution system based in Nairobi by 2017. By 2030, this might potentially reduce to 30% if volume growth continues as per estimated future projections.

Implementing the three DC scenario requires prioritization and investment. We recommend a three-phased approach:

- **Phase 1:** This requires rolling out Kisumu first and then Mombasa without major infrastructural upgrades. We estimated the optimal size for the Kisumu DC to be 2,000-pallet spaces, which would require the warehouse to be significantly upgraded (from 620 pallet spaces). However, with some modifications to the optimal delivery footprint of Kisumu, the DCs could in the short-term start delivering to RHFs in selected counties without requiring major changes.
- **Phase 2**: This requires upgrading the facilities to the required capacity levels. This would include upgrading Kisumu, Mombasa and Nairobi. We estimated that, with the required changes in procurement policies and practices, the Nairobi DC would require expanding the current 9,200 pallet spaces to 16,000 pallet spaces. Current procurement practices often do not spread delivery into multiple smaller deliveries throughout the year. If these procurement practices are not changed, the Nairobi warehouse could require even more pallets spaces (up to 32,000 pallet spaces in 2030). With current pressures experienced concerning warehouse capacity constraints, we recommend that current procurement practices be addressed as a matter of urgency. In addition, stocks that are not moving should be removed from the warehouse to create space for actively distributed commodities. The Kisumu DC would relieve some pressure in the short-term, but not nearly enough to resolve the current issues experienced.
- **Phase 3**: This involves another review of the KEMSA logistics network design, as enough time would have passed to allow for some of the demand projections to have been realized. This would be the right time to provide additional insight into potential future expansion of KEMSA and determine whether more changes to the network configuration would be required.

1 STRATEGIC NETWORK OPTIMIZATION OVERVIEW

1.1 INTRODUCTION

In May 2011, USAID awarded the two-year KEMSA Support Program to Deloitte Consulting LLP as the lead implementing partner. The goal of the program is to strengthen KEMSA's ability to provide client sites throughout the country with the right quantity of quality commodities, in a timely manner, for effective service provision. This is achieved through execution of the following five tasks, which are aimed at improving KEMSA's business operations.

1. Review KEMSA's Legal Status (KEMSA Act) and make recommendations to strengthen its operational mandate
2. Strengthen KEMSA's governance architecture and practice
3. Strengthen KEMSA's inventory management and tracking
4. Strengthen KEMSA's warehouse and distribution
5. Support for KEMSA to develop, implement and monitor a performance monitoring plan

The Strategic Network Optimization (SNO) analysis supports the fourth task listed above, through improving KEMSA's physical warehousing network structure to achieve optimal responsiveness of distribution of commodities. The following analysis provides prioritized future state scenarios, future demand projections through use of simulations, key recommendations and an implementation roadmap.

Despite operational setbacks experienced over the years, KEMSA has managed to implement a centralized supply chain network, establishing scheduled deliveries to all of its over 4,000 customers through an outsourced transport system.

Currently, KEMSA distributes the majority of medical commodities from Embakasi warehouse based in Nairobi, through third party transporters. Select program commodities are distributed from KEMSA's Commercial Street warehouse in Nairobi through courier services. Plans are underway to move all the distribution to Embakasi warehouse. KEMSA operates eight regional depots based at Eldoret, Garisa, Kakamega, Kisumu, Meru, Mombasa, Nakuru, and Nyeri.

Figure 1: Location of Current KEMSA Depots

Currently, the depots function as storage locations with no distribution of commodities to health facilities, though facilities may on occasion, collect commodities from depots. In some instances, facilities do not have enough storage space and an arrangement is made with KEMSA to store commodities in the depot closest to them.

Although most health facilities are within reach of Nairobi, a decentralized approach may offer better customer service while at the same time offering a

more cost effective distribution solution if more frequent deliveries are required, compared to the centralized structure. To prepare for the requirements of decentralization, KEMSA undertook a SNO exercise to compare the current state against potential future state scenarios and to get a better understanding of the cost and infrastructural requirements of moving towards a decentralized approach.

The objectives of the SNO analysis were to design and develop the future state of the KEMSA distribution network taking into account the future changes in demand, political environment, and mandate. This will assist KEMSA to improve the planning processes for strategic placement of DCs in Kenya. The main objectives were:

- Develop multiple options for future state scenarios that would address the potential alternatives for KEMSA's future logistics network; and
- Prioritize the future state scenarios such that a single scenario can be chosen as the optimal solution for KEMSA. The scenarios will help advise on how many DCs are required, their locations, and their required capacity.

To achieve the objectives, an understanding of the current KEMSA logistics network costs, projected future growth, and future state logistics costs was required. Comparing logistics network costs between various future state scenarios and understanding potential benefits to KEMSA customers would enable KEMSA to select the most appropriate path forward.

This report outlines the approach and findings from the SNO analysis.

1.2 APPROACH

We used Deloitte network analyses and experience customized for KEMSA for the SNO analysis that includes:

- Alignment to the KEMSA strategy;
- Current state assessment and building of a current state model;
- Development of design principles for future state scenarios;
- Building of a baseline simulation model;
- Development of future state scenarios and simulation models for selected scenarios; and
- Development of a case for change and implementation roadmap.

The alignment phase included the review of KEMSA's strategic plan and interviews with key KEMSA stakeholders to capture requirements. The stakeholders were engaged on a one-on-one basis as well as in a collaborative workshop to gain an understanding of the potential challenges and constraints that require consideration. The purpose of the interviews and workshop were to review the current KEMSA network and future supply chain strategies and to understand and align KEMSA's expectations for a SNO analysis.

The current state assessment and the definition of the simulation model required defining the full set of data requirements and collecting the data. Part of the assessment was to conduct site visits to the central warehouses, regional depots and selected health facilities to gain an understanding of operational constraints. Following the site visits, data was gathered and cleaned. A list of guidelines that directed the analysis were then developed and agreed upon with KEMSA.

In the current simulation modeling phase, the current state scenario was built into a software model to provide insight into the current state costs. Two baseline models were built using CAST supply chain network design software. This was done to provide a means of calibrating key transportation parameter

assumptions. The baseline models used adjusted volumes and industry transportation rates as explained in Section 3.1. These models were validated and agreed on with KEMSA senior management, prior to conducting the future state scenario analysis.

A Technical Working Group was formed and included KEMSA representatives from Customer Service, Distribution, Finance, Procurement and Warehouse Departments. During a number of working group sessions, the future state scenarios selected by KEMSA senior management were defined in more detail with the Technical Working Group and presented to KEMSA senior management for decision-making and selection of the final scenario list.

We built software models for the agreed future state scenarios and analyzed results. All outputs of the report were reviewed and validated with KEMSA management. The analysis is described in Section 1. Section 4.2 discusses an implementation roadmap developed and agreed upon with KEMSA management.

2 CURRENT STATE NETWORK ANALYSIS

The current state network analysis included an in-depth analysis of the commodities distributed by KEMSA as well as a commodity flow analysis to better understand the impacts of stock holding on the distribution network. KEMSA financials were analyzed in order to define the current state model and calibrate model assumptions used in future state scenarios.

In addition to the main warehouse in Embakasi, six KEMSA warehouses and depots were visited (Commercial Street, Eldoret, Kakamega, Kisumu, Mombasa and Nakuru) during the duration of the analysis. Table 1 details the depot sizes.

Table 1: Current State Depot Sizes

Location	Size (m^2)	Pallet Spaces	Type
Embakasi	15 329	9 200	DC
Commercial Street	3 902	2 000	DC
Nyeri	552	360	Depot
Kisumu	843	628	Depot
Eldoret	552	360	Depot
Nakuru	552	360	Depot
Mombasa	538	320	Depot
Garissa	186	72	Depot
Meru	186	72	Depot
Kakamega	186	72	Depot

In visiting the depots, a more in-depth understanding of the KEMSA operating environment was achieved. Some of the major findings were:

- The depots are small and have minimum staff;
- The depots are used mainly as storage depots for overflow commodities when the central warehouses are full;
- The depots have no racking and limited roof height which limits storing of large quantities;
- Some of the depots have major safety concerns – such as unsafe storage methods and possible safety hazards;
- The depots are not always on the main roads which may pose difficulties if a depot is converted to a DC and large commodity consignments were to be delivered to the location in future;
- Depots such as Kisumu and Mombasa has adequate land for warehouse expansion; and
- There is a shortage of storage space at the facilities which points to a requirement for more frequent deliveries.

During the site visits it was reported that a shortage of storage space at the facilities was a problem. This was evident when visiting the General Provincial Hospital in Kakamega. This problem seems to be exacerbated by the reduction of the frequency of deliveries to hospitals from six times per year to four times per year. Hospitals currently have to store three months of stock instead of two months.

Data Gathering and Assumptions

The model is defined based on a key selection of data elements which was obtained from KEMSA's ERP system. It is based on a twelve-month period from July 2011 to June 2012.

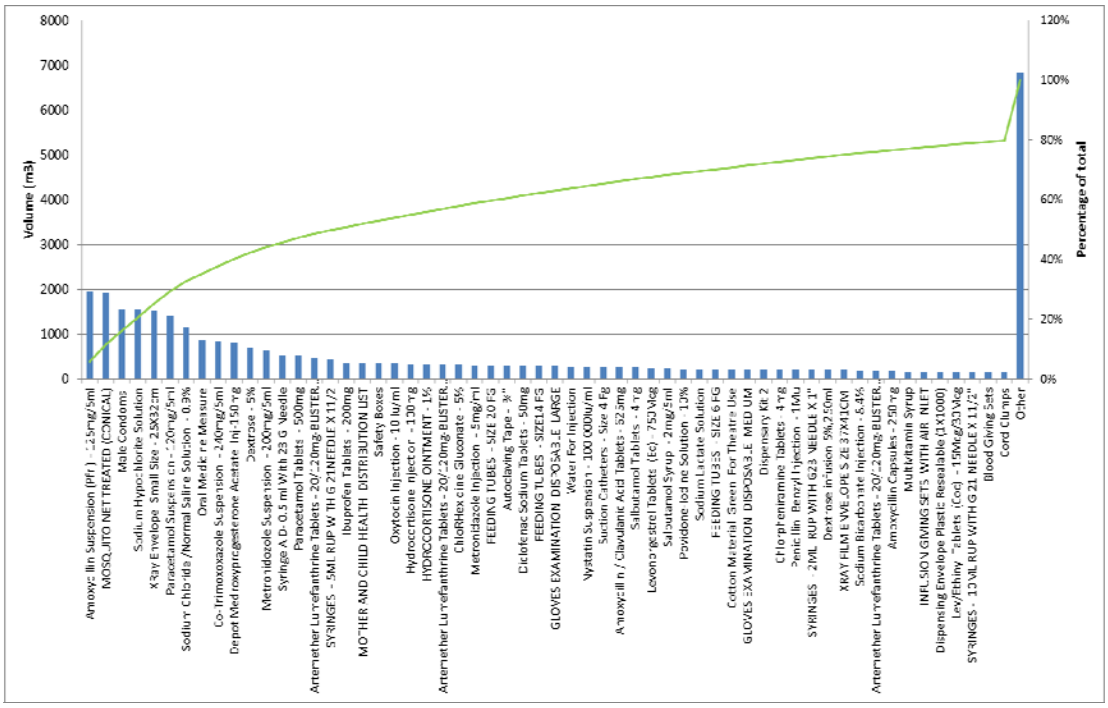
The data includes transactional data for the specified period such as order and shipment data. The shipment data includes the commodity codes and descriptions; date ordered; facility name; product category; and quantity issued.

Volume Calculations

To determine the flow of volume through the warehouses, quantity issued data was multiplied by the defined volume per unit issued. Where the volume per unit was not available, assumptions were made. These assumptions were reviewed with and agreed to by KEMSA's Distribution and Warehouse Departments.

Based on the data set, 447 unique commodities were identified at the Embakasi warehouse and 377 commodities at the Commercial Street warehouse. To determine the unit volumes for these commodities it was decided to measure the actual sizes of the boxes for the commodities that made up 80% of the volume as this typically would give a good indication of the bulk of volumetric requirements. To identify these commodities, the number of boxes per product was calculated by using the total quantity issued divided by the number of units that make up a box. We identified 62 products as having 80% of the boxes distributed. These actual box sizes were measured to determine actual volume in cubic meters per unit. For the remaining 20% of commodities, a medium-sized KEMSA box was used, which equated to 69,640 cm^3. This was used to determine the volume of each unit distributed. The defined volumes was tested against the current state volumes which included the comparison of the actual number of trucks used and was found to be accurate for the required modeling purpose. The figure below shows the top 62 products that make up 80% of the volume. All other products are recorded under "Other".

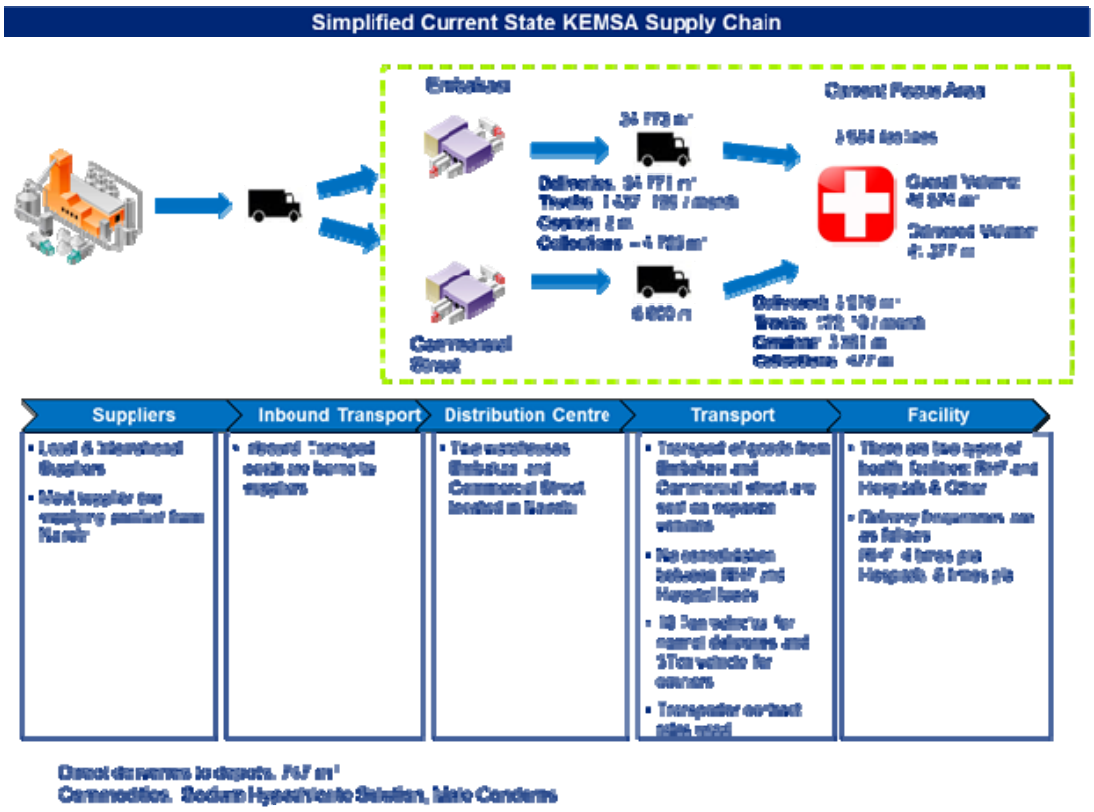
Figure 2: Commodity Volume Analysis



Network Assumptions

Figure 3 outlines the current state scenario assumptions. Approximately 46,574m^3 was delivered to 3,984 public health facilities, 34,773m^3 from the Embakasi DC and 6,600m^3 from the Commercial Street DC. Supplier deliveries to Embakasi and Commercial Street DCs were not modeled as the cost was borne by the suppliers and not indicated separately from the commodity cost. Two vehicle types were defined based on agreed parameters: 10-ton vehicle for normal deliveries and three-ton vehicle for courier deliveries. Rural health facilities received four deliveries per year and hospitals & other facilities (e.g., district stores) received six deliveries per year. The figure below depicts a simplified version of the current state KEMSA supply chain. The diagram provides of view in volumes of how much KEMSA is current distributing and to how many facilities.

Figure 3: Overview of KEMSA's Current State

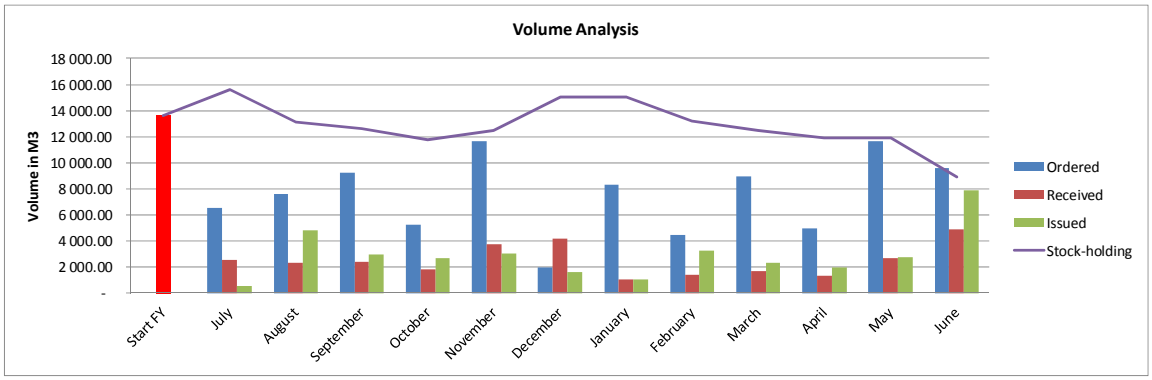


2.1 COMMODITY FLOWS

Issue, receipt, order and starting inventory data for the period from 1 July, 2011 to 30 June, 2012 were used to analyze the commodity flow trends. Figure 4 provides a high-level view of the total volume and stockholding over a 12-month period. We made the following observations:

- There were high levels of orders being placed, yet there were relatively low fill rates;
- There was a large amount of starting inventory on hand which was not moving through the year; and
- There were high levels of procurement, which had an impact on the space in the warehouse.

Figure 4: Total Volume Flow Analysis



The figure above is a screenshot of the graphical outputs from a basic inventory tool developed for KEMSA. This graph shows the stock on hand in volume, in total and per product over a 12-month period. Our general findings from the commodity flow analysis included:

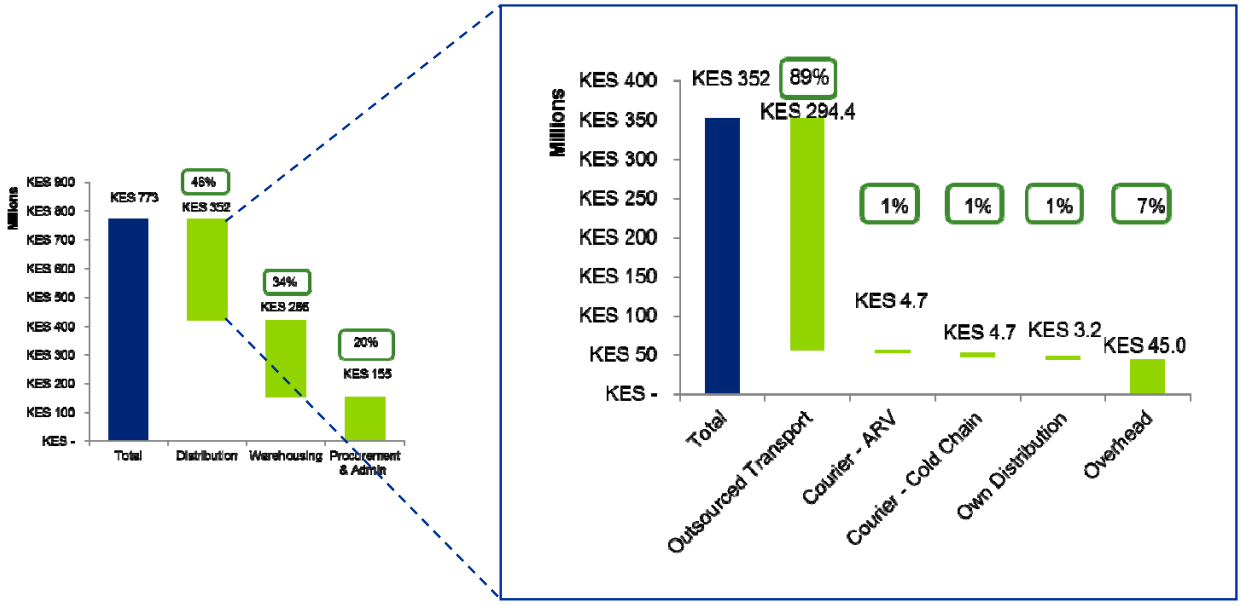
- There were high levels of overall stock in the warehouse, although there were multiple occasions of stock outs at the individual commodity level;
- There was ordering of stock for certain commodities even though there were high volumes of stock in the warehouse. This contributes to the lack of space in the warehouse and provides a warning signal that if ordering does not match demand as measured in days of cover, the current overstocking of some commodities can potentially lead to future expiries; and
- There was a lack of demand forecasting based on customer needs and requirements and corresponding limited ability to fill orders placed.

2.2 FINANCIALS

Understanding KEMSA's current state financials was key in calibrating model parameters used to build future state scenarios. It also formed the basis for validating and agreeing on the baseline model with KEMSA. This section describes KEMSA's current state financials and the numbers that were relevant in calibrating the baseline model. It also provides the results for the current state scenario that were built in order to gain insight into the cost of the current KEMSA logistics network.

2.3.1 KEMSA Financials

Figure 5: Total Logistics Costs and Distribution Cost Breakdown



The graph indicates that 80% of KEMSA's operational costs are made up of warehouse and distribution. Within distribution, 89% of costs are made up of outsourced transport.

In the financial year 2011/2012, 80% of total operational costs consisted of distribution and warehouse costs with the 20% consisting of Procurement and Administration costs. Procurement and administration costs not only include the Procurement Department costs, but also general overhead costs such as the office of the Chief Executive Officer. Guidelines for allocating overhead cost were reviewed with KEMSA's Finance, Information and Communications Technology and Operations Departments and was agreed to with KEMSA's Finance Manager.

Within the breakdown of KEMSA's distribution costs, outsourced transport comprised the largest proportion of distribution costs at 89%, followed by overhead costs at 7%. Courier costs contributed 2% and KEMSA's own distribution costs represented 1% of the distribution costs.

Outsourced transport refers to the cost of transport that can be attributed to the external transporters (non-couriers). Courier costs are from service providers, G4S and BM Logistics, delivering anti-retrovirals (ARVs) and cold chain commodities. It must be noted however, that at the time of doing the analysis, some courier costs were not available, as not all the invoices were received from service providers. The courier costs were therefore understated. From the information that was available, it was not clear what the split between ARVs and cold chain commodities were. It was therefore agreed with KEMSA's Finance Department to perform an equal cost allocation of KES 4.7 million between these categories. KEMSA's own distribution costs are the incurred costs to run and maintain delivery vehicles owned by KEMSA. Overhead refers to indirect costs that could be attributed to the Distribution Department.

The distribution costs were used to calibrate logistics network costs in the following way:

- Outsourced transport costs were used to calibrate deliveries from the Nairobi DC to the facilities; and
- Courier costs were used to calibrate delivery of commodities delivered via couriers.

In collaboration with KEMSA we decided to exclude KEMSA's own vehicles from the analysis, as these costs are relatively low in comparison (less than 1%). These vehicles are only used by KEMSA on an exceptional basis and it was decided not to include them in designing future states.

2.2.1.1 Current State Modeling Results

Figure 6 details the distribution costs results for the current state model. The current state model was built using the contractual transporter rates for the applicable period and indicates the expected financial results if exceptions and emergency deliveries were to be excluded.

The total distribution costs for the current state software model came to KES 339 million versus KEMSA's actual financials (management accounts) of KES 352 million – a variation of 3.6%. This variation is within acceptable range.

The current state model results shed some light on what the split between courier ARV delivery costs and courier cold chain delivery costs could be. In Table 2, the courier ARV costs amounted to KES 10.1 million and the courier cold chain to KES 0.9 million, which gave a 91.7% and 8.3% cost split respectively. This resulted in a total courier cost of KES 11 million compared to the KES 9.4 million stated in KEMSA's actual financials.

Table 2 provides a breakdown of costs between RHFs, hospitals and couriers. Deliveries for RHFs account for 63%, versus 33% for hospitals. Courier costs only make up 3%.

Although RHF distributed volumes (14,816m^3) were 36% less than that of the hospitals (23,178m^3), and RHF received four deliveries per year versus the six deliveries per year for hospitals, it cost 88% more to deliver to the RHFs. That is reflective of the additional difficulties in delivering to RHFs, as the volumes are much smaller than that of hospitals and they are located in remote and difficult to reach areas.

Figure 6: Distribution Costs – Current State Scenario

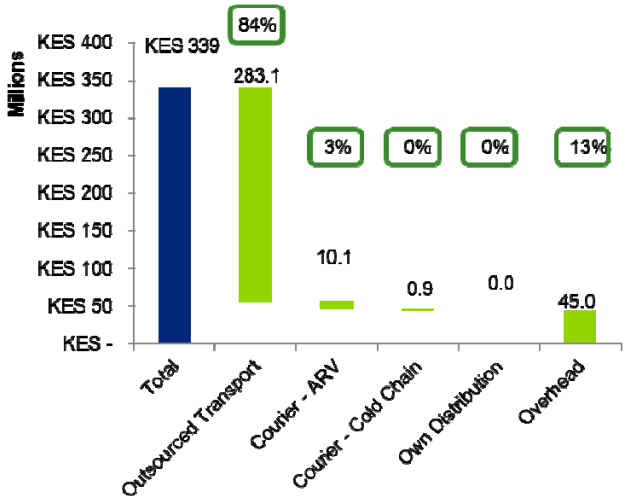


Table 2 Distribution Costs by Channel – Current State Scenario

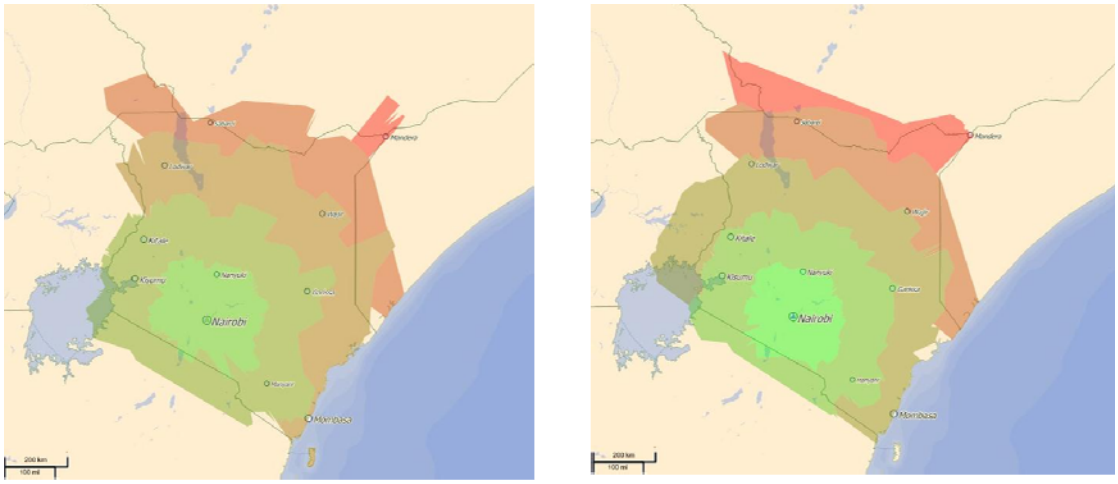
Transport Type	Cost (KESm)	Volume (m^3)	Cost / Volume ('000)
RHF	KES 184 999	14 816	KES 12 5
Hospitals & Other	KES 98 088	23 178	KES 4.2
Courier	KES 11 061	3 383	N/A: Missing Proof of Deliver Data
Total:	**KES 294 149**	**41 377**	**KES 7.1**

2.3 SUPPLY CHAIN RESPONSIVENESS

To model the customer service point of view, we ran a supply chain responsiveness scenario, as shown in Figure 7. We agreed with KEMSA to measure the supply chain responsiveness in number of travel hours required to reach a facility from the supplying DC. Travel speed was adjusted for Kenyan road conditions.

Currently 39% of the volume delivered to health facilities is within four hours reach. Similarly 34% of the delivery points are within 404kms reach. In Figure 7 this is referred to as % demand reach. The map below highlights in time and distance how responsive the KEMSA supply chain is with one DC.

Figure 7: Heat Map: Responsiveness of the Current KEMSA Logistics Network



Delivery Lead Time	% Demand Reach
4 Hours	39%
8 Hours	49%
12 Hours	9%
16 Hours	2%
20 Hours	1%

Distance	% Demand Reach
202 kms	34%
404 kms	46%
606 kms	14%
808 kms	3%
1 010 kms	1%

3 FUTURE STATE NETWORK ANALYSIS AND KEY FINDINGS

3.1 BASELINE MODEL

We used baseline models to calibrate model assumptions and normalize the demand profiles in preparation of the future state models.

There are two main differences in assumptions between the current state and the base case scenarios:

1. Where Embakasi and Commercial Street were modeled separately in the current state, a single location in Nairobi was modeled in the baseline model. Commercial Street will not be used in the future as a DC, but instead may be retained as an overflow warehouse. All commodities were modeled as flowing through a Nairobi warehouse.
2. Vehicle industry rates were used as opposed to the transporter contracted rates to ensure that a non-biased costing structure was used for future state cost comparisons.

The same demand data that we used in building the current state scenario was used as input to building Base Case A and Base Case B. In Base Case A, however, no changes were made to the current state demand data, as it was needed for calibration of model parameters such as vehicle utilization and travelling speeds. In Base Case B, current state demand data were normalized and the results were used as the demand data for Base Case B in order to understand the impact of the normalization.

Part of the data normalization process was the exclusion of all data that was once off or extraordinary deliveries by KEMSA. The exclusions were agreed with KEMSA and include the following examples:

- All economic stimulus and once off delivery volumes such as mosquito nets were removed from the data set.
- From an analysis of the issues data it became apparent that the Essential Medicines and Medical Supplies (EMMS) products for hospitals and RHFs were lower than their drawing rights (i.e., budget allocation) for 2012/2013. For Base Case B the volumes were adjusted to reflect full potential volumes.

Vehicle cost assumptions were agreed using industry rates as a basis. To ensure the right vehicle utilization and travelling speed, parameters were defined for future state models. These parameters were calibrated and the resulting costs were compared against KEMSA's financials.

A five-year old, 10 ton vehicle was assumed at KES 140.40 per kilometer. As there were no load consolidations between hospital and RHF deliveries, capacity utilization was assumed at 99% for hospital vehicles and 80% for RHF vehicles. Travelling speeds were calibrated at 90% of travelling speeds that could be expected in developed countries. Different travelling speeds for different road types were assumed, e.g., main roads (highways) would have an average speed of 80kms/h in developed countries and rural roads an average of 25kms/h. Two personnel were costed with the driver at KES 309.66 per hour and loader at KES 103.22 per hour. Twelve-hour shifts were assumed at five days a week of which four hours per shift were allocated for breaks. Overnight allowances were costed at KES 4,000 per night for the driver and KES 2,000 per night for the loader. In all cases where industry transport rates were used, a 20% markup was assumed and added to the model results in order to estimate transport costs if it were to be outsourced.

It is important to note that although care was taken to calibrate the model as closely as possible to the KEMSA financials and results of the baseline model were validated with key KEMSA staff, the results are

only indicative of expected transport costs. These assumptions are used in a comparative way only. It was not used to determine absolute figures, and is therefore deemed fit to be used to design the future states.

Figure 8 compares the financial results between KEMSA financials and Base Case A. Outsourced transport costs total KES 294.4 million for the KEMSA financials compared to KES 304.9 million for Base Case A. This means the vehicle transportation costs using industry rates were calibrated within 3.6%. Typical tolerance levels are normally within 10%. For example, capacity utilization of the RHF vehicles was assumed at 80% of the vehicle volumetric capacity. Hospital vehicle had greater capacity utilization which was calibrated at 99% of the vehicle volumetric capacity.

Figure 8: Distribution Cost Comparison: KEMSA Financials versus Base Case A

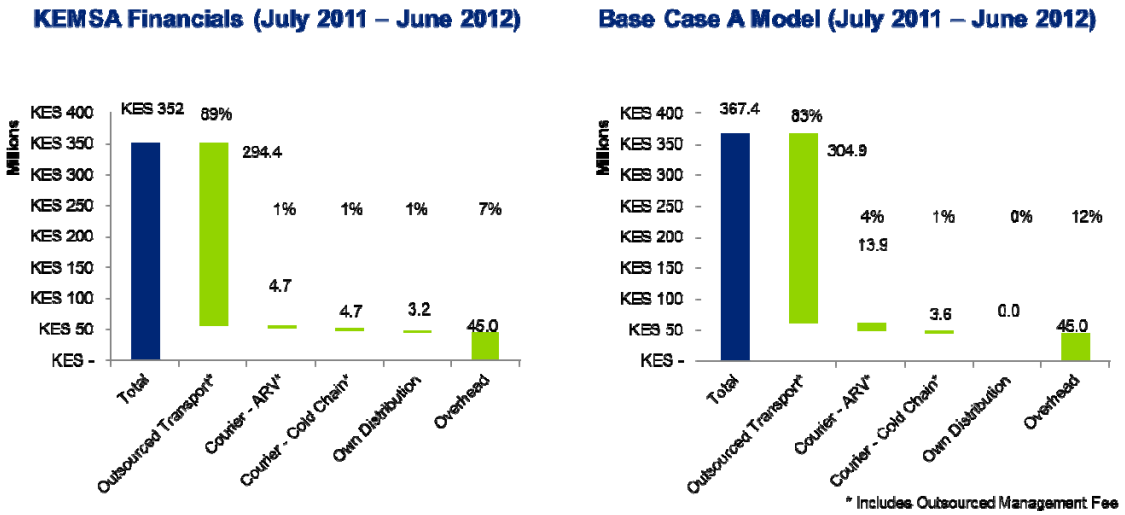
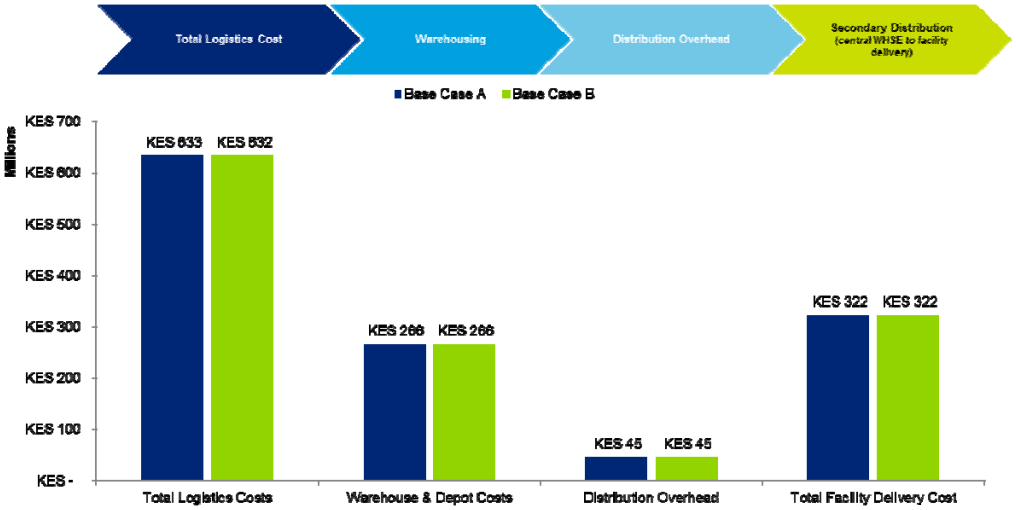


Figure 9 compares Base Case A and B scenarios in order to determine the impact of the revised demand profile. It shows comparable facility delivery costs at KES 322 million with no impact to demand profile.

Figure 9: Total Logistics Costs: Base Case A versus Base Case B



However, if the unit costs by distribution channel are investigated, the impact of the new demand profile is evident. In Base Case B, although the hospitals have 21.6% more volume, roughly 23,200 m^3 in Base Case A versus 28 200m^3 in Base Case B, the total transportation cost comes down to 4.6% (KES 125 million versus KES 120 million). Normally one would expect the costs to increase with an increase in volume – assuming the same level of consolidation is achieved. However, the load consolidation has improved due

to quarterly instead of bi-monthly deliveries, lowering unit costs by 21.6% from KES 5,410/m^3 to KES 4,244/m^3.

3.2 FUTURE STATE SCENARIOS

In order to develop future state scenarios, logistics network design principles and demand projections were required. In this section the design principles, demand projections and future state scenarios are discussed.

3.2.1 Design Principles

The design principles were essential for determining the future state scenarios. To ensure the future state scenarios are viable for the KEMSA operating environment and Kenyan environment, the design principles were determined prior to design of future scenarios. The following design principles were agreed to with key KEMSA stakeholders.

- KEMSA will operate within the boundaries of KEMSA's mandate and the National Health Policy.
- Decentralization will be driven by county structure and the impact of decentralized DCs on the business model needed to be evaluated, including operating cost impact.
- Constraints in terms of capital and increases in operating costs had to be evaluated.
    - Emphasis should be on optimal model not capital constraints, although the expenditure cannot be completely unrealistic and must be justifiable through a business case.
    - A guideline of operating cost increases between 15% to 30% was agreed to with KEMSA. Feedback was provided based on simulation model findings. Where there were high operating cost increases the impact and alternatives were reviewed.
- Road transport was the primary transport mode and was the only mode modeled in the simulation.
- Current depots can be closed (if required) and new DCs opened as required to drive efficiencies.
- DCs will be established in optimal locations as guided by service delivery time within eight hours, based on delivery time and optimized distribution cost.
- Each facility will only be served from one DC to allow for efficient planning.
- Frequency of deliveries from DCs to facilities was reviewed. More frequent deliveries were considered with higher and lower delivery frequency comparisons.
    - Deliveries were optimized for RHFs and hospitals through combined routes and loads.
    - Vehicle sizes were determined as per ordering patterns and delivery rules.
- Supplier inbound deliveries were routed through Nairobi as a rule.
    - Centralized quality assurance (QA) was expected to be the norm with operational exceptions with a travelling QA team. Supplier container sizes may make it impractical to deliver directly to DCs. Mombasa was reviewed as a potential exception.
    - From a modeling perspective, QA was central.

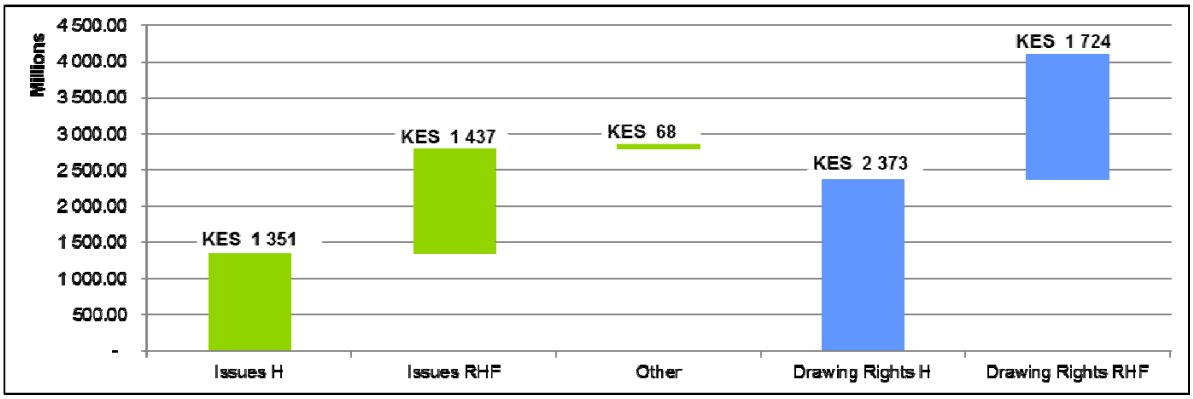
3.2.2 Demand Projections

Demand projections were required until 2030 in order to model the future state scenarios. A summary of the steps taken to arrive at the demand projections is described below.

Step One: From an analysis of the issues data it became apparent that the EMMS products for hospitals and RHFs were lower than their drawing rights (i.e., budget allocation) for 2012/2013. Figure 10 shows that the total RHF drawing rights for 2012/2013 was KES 1,724,280,095 whereas the total value of issues for that year were KES 1,437,795,043. Similarly for hospitals, issues were KES 1,351,535,461 and drawing rights were KES 2,373,284,676. This means that for hospitals, drawing rights were significantly higher than issues and a correction needed to be made before projecting future demand. The 'other' amount was for all other issues to facilities without drawing rights such as district stores.

The figure below shows the analysis of drawing rights for hospitals and RHFs. The green bars show actual issues on drawing rights. The blue bars reflect the allocated drawing rights for the year. The current drawing rights are significantly higher than the current issues.

Figure 10: Breakdown of Drawing Rights for Hospitals and RHFs



Step Two: In order to improve the accuracy of the demand projections, we decided with KEMSA to increase the demand projections for hospitals and RHFs to their drawing right's ceiling. It was further identified that there were 580 new RHFs on the Drawing Rights Allocation List for 2012/2013. These new RHFs were not on the previous KEMSA facilities list. An analysis of each of these facilities was conducted in ordered to attain the GPS coordinates of the facilities. The e-Health Kenya website was used to locate the coordinates (http://www.ehealth.or.ke/facilities/). When the facility was not found on the e-Health website, Google Maps was used to locate the facility. When this option was also not available, the closest town to that facility was found and those coordinates were used. A further analysis was done to ensure that multiple facilities were not placed on the same coordinates in the same town. If this was the case, a manual adjustment of 10kms was instituted. Thereafter, the 580 new facilities drawing rights were converted into volumes and added to the previous volumes.

Step Three: Following the above adjustments, the commodity volumes were increased on average by 20% across the board year by year for a five-year period to further counter the low fill rates and funding gaps. The additional volumes moving to KEMSA from the USAID-funded Supply Chain Management System project for rapid test kits distribution was also covered by the 20% increase.

Overall projection numbers were aligned to the forecasting estimates in the USAID DELIVER project's *Kenya: 2020 Supply Chain Modeling - Forecasting Demand from 2020–2024* report. In this study the global standard of population growth of 2.1% were applied and assumes adequate funding and that KEMSA will be fully mandated to fulfill 100% of demand. The current Kenyan population growth is at

2.8%. It must be noted however that Kenya Vision 2030 has expressed the need for lower population growth over the long term.

Step Four: A further analysis was conducted on the *National Forecasting & Quantification for HIV & AIDS Commodities for the Years 2010/11 & 2011/12* report for Kenya. The aim of this additional analysis was to understand required volume growth for key selected commodity groups which does not cover the full distribution footprint, but is delivered to a subsection of the full facility list such HIV and AIDS treatment and prevention commodities. It is envisaged that KEMSA will take over the distribution of HIV and AIDS commodities from Kenya Pharma in the near future.

Figure 11 depicts the demand projections up until 2030. By 2017, the volume is projected to grow by 160% from current volumes. By 2030, the volume is projected to grow by 454%. Value is based on commodity prices provided by the procurement department.

Average growth for the first five years was at 20%. Thereafter, growth was projected at 6% growth per year in line with perceived year on year growth. It is anticipated that the 20% annual growth for the first five years will address the current shortfalls in meeting current demand. By Year Five KEMSA hopes to be addressing the demand requirements, this makes the case for more moderate growth after Year Five.

Figure 11: Projected Volumes up to 2030

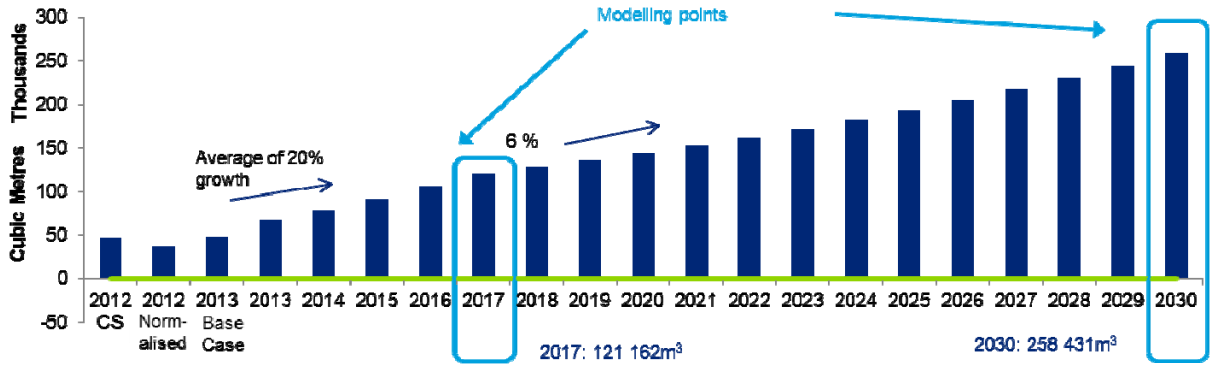


Table 3 below indicates the projected volumes and values for KEMSA up until the year 2030. Note that the 2020 and 2024 projection numbers were aligned to *Kenya: 2020 Supply Chain Modeling - Forecasting Demand from 2020–2024* report, and the 6% trend extrapolated to 2030. An exchange rate of 84 KES to one dollar was used.

Table 3: Projected Volumes up to 2030

Year Ending		Volume (m^3)	Value (KES)	Value ($)
2012	Current State	46,574	KES 23,908,720,665	$ 284,627,627
2012	Normalized	36,728		
2012	Base Case	47,847	KES 28,712,803,071	$ 341,819,084
2013	Year 1	67,832	KES 39,552,969,619	$ 470,868,686
2014	Year 2	78,416	KES 45,800,929,484	$ 545,249,161
2015	Year 3	91,416	KES 53,427,099,815	$ 636,036,903
2016	Year 4	105,941	KES 61,913,688,790	$ 737,067,724
2017	**Year 5**	**121,162**	**KES 63,173,726,624**	**$ 752,068,174**
2018	Year 6	128,432	KES 66,964,150,221	$ 797,192,265
2019	Year 7	136,138	KES 70,981,999,235	$ 845,023,800
2020*	Year 8	144,306	KES 75,240,919,189	$ 895,725,228
2021	Year 9	152,965	KES 79,755,374,340	$ 949,468,742
2022	Year 10	162,143	KES 84,540,696,801	$ 1,006,436,867
2023	Year 11	171,871	KES 89,613,138,609	$ 1,066,823,079
2024*	Year 12	182,183	KES 94,989,926,925	$ 1,130,832,463
2025	Year 13	193,114	KES 100,689,322,541	$ 1,198,682,411
2026	Year 14	204,701	KES 106,730,681,893	$ 1,270,603,356
2027	Year 15	216,983	KES 113,134,522,807	$ 1,346,839,557
2028	Year 16	230,002	KES 119,922,594,175	$ 1,427,649,931
2029	Year 17	243,802	KES 127,117,949,826	$ 1,513,308,926
2030	**Year 18**	**258,431**	**KES 134,745,026,815**	**$ 1,604,107,462**

3.2.3 Future State Scenarios Overview

There were multiple future state scenarios that were built during the analysis. There were a number of key questions that were asked in order to develop the future scenarios. These include:

- What is the optimal number of DCs?
- Where should they be located?
- How big should they be?
- What is the replenishment policies to the regional DCs?
- What is the stock holding policy and frequency of replenishing stock from the central DC?

To answer these questions, a Centralized Distribution model (i.e., the current state distribution strategy) was needed to compare all future state scenarios against. This is referred to as “Scenario 1: Centralized Distribution”. The cost comparisons will provide an indication if the future state alternatives are more cost effective or less cost effective than the Centralized Distribution scenario.

To see the impact if an extreme scenario such as having a DC in every county would be implemented, "Scenario 2: DC in Every County" was defined. This would place a DC in every county and would reflect the best service delivery reach that could be provided.

Scenario 3 was defined to determine the most optimal network configuration for KEMSA going forward. It was envisaged that the placement of DCs for the optimal network configuration may not always be placed in the most practical locations and that the simulated results may have to be adjusted based on additional intelligence over and above the software parameters. This will lead to a rationalized scenario. The purpose of "Scenario 4: Rationalized Future State Model" was to determine the impact of rationalizing the optimal configuration. It was also envisaged, that once the rationalized network configuration was known, that there would be some scenario variations.

Based on the rationalized future state model, two additional future state models were investigated. They were:

- Alternatives to Mombasa as the third DC; and
- Kisumu Two DC Scenario to assist with phase 1 of implementation plan.

The assumptions and findings of these scenarios are discussed in Section 3.2.10 and 3.2.11.

It is important to note that future state scenarios with more than one DC would require different types of transport. These types of transport are often referred to as primary transport and secondary transport. Primary transport refers to transport that is used to deliver commodities from the centralized distribution center (CDC) to the regional DCs (i.e., replenishment orders). Secondary transport refers to transport that is used to deliver commodities from any of the DCs to the facilities.

In the centralized distribution strategy, no primary transport is required. In the decentralized strategy, both primary and secondary transport is required. As more DCs are added to the logistics network, secondary transport costs reduce, while primary transport costs as well as DC operating costs increase. DC operating and transport costs assumptions are therefore required for the decentralized future state scenarios.

Annual DC operating cost assumptions were developed for various DC sizes. Cost assumptions were developed for DCs with capacities of 300 pallet spaces up to 32,000 pallet spaces. Table 4 indicates the annual operating cost assumptions for the various DC sizes.

Table 4: Annual DC Operating Cost Assumptions

DC Capacity (Pallets)	Fixed Annual Operating Costs	Variable Costs per m^3
300	KES 23,864,584	KES 129,399
600	KES 31,819,445	KES 129,399
1,000	KES 39,619,356	KES 129,399
2,000	KES 56,867,338	KES 129,399
3,000	KES 71,059,463	KES 129,399
5,000	KES 100,789,799	KES 129,399
9,000	KES 141,105,718	KES 129,399
16,000	KES 225,769,149	KES 129,399
32,000	KES 316,076,809	KES 129,399

3.2.4 Scenario 1: Centralized Distribution

For the centralized model the same assumptions were used as with the baseline models, except that the demand profile used was 2017 and 2030 demand projections – depending on the comparison that needed to be made. Future state scenarios were either compared to the 2017 or 2030 demand projections. Some future states also compared monthly to quarterly deliveries. The following demand profiles were used:

- 2017 demand projections with quarterly deliveries;
- 2017 demand projections with monthly deliveries;
- 2030 demand projections with quarterly deliveries; and
- 2030 demand projection with monthly deliveries.

A single DC in Nairobi was defined with the same transport industry rates assumptions used as in the baseline models.

Figure 12: Delivery Footprint – Centralized Model

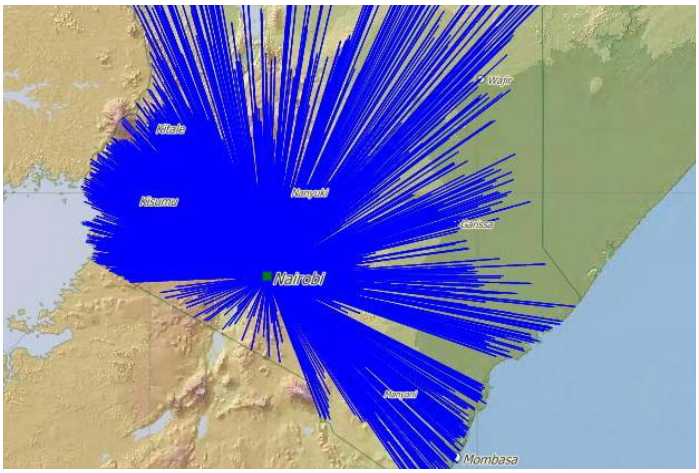
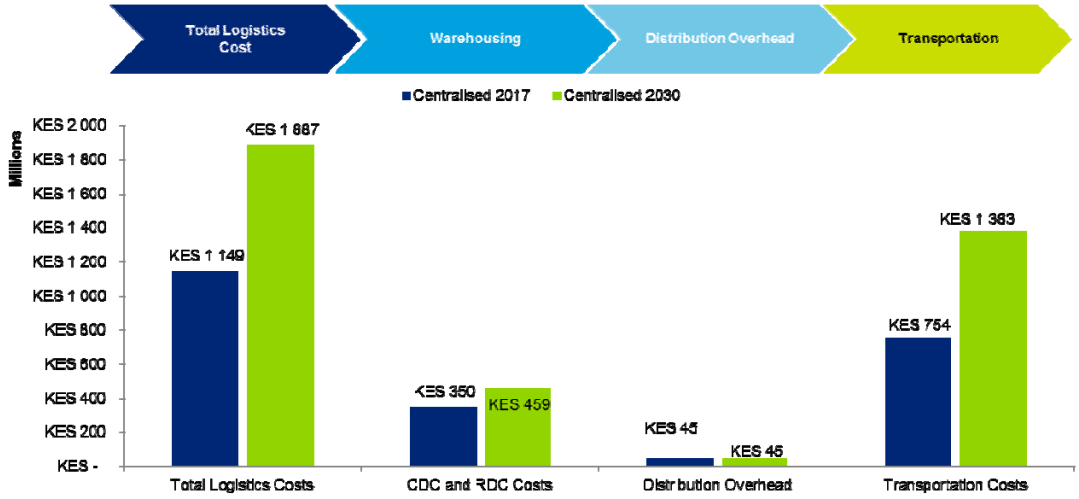


Figure 12 illustrates the delivery footprint for the Centralized Distribution Scenario.

Figure 13 outlines the detailed costing results for the Centralized Distribution Scenario. The future state scenarios are compared with these costs to determine ideal network configuration for KEMSA. Total logistics network costs for 2017 amounts to KES 1,149 million in 2017 and KES 1,887 million in 2030. These costs are split into warehousing costs, distribution overhead and transportation costs. Total warehousing costs (including warehouse overhead) amounts to KES 350 million in 2017 and KES 459 million in 2030. Distribution overhead costs were kept the same for ease of comparison. Transportations costs amounted to KES 754 million in 2017 and KES 1,383 million in 2030. The volume distributed in 2017 is 121,164m^3 versus 258,431m^3 in 2030.

Figure 13: Detailed Costing: Centralized Distribution Scenario



Scenario	Cost / Volume	Total Logistics Costs	Warehouse & Depot Costs	Distribution Overhead	Transportation
Centralised 2017	KES/m³	KES 9 485	KES 2 892	KES 371	KES 6 221
Centralised 2030	KES/m³	KES 7 300	KES 1 774	KES 174	KES 5 351

Volume 2017: 121 164 m³
Volume 2030: 258 431 m³

3.2.5 Scenario 2: A DC in Every County

3.2.5.1 Analysis Overview

The initial future state scenario considered was a DC in every county. The importance of this scenario – even if not cost effective –was to prepare KEMSA for potential inquiries regarding DCs in the counties due to the move to the county governance structure.

The first set of assumptions for this scenario were the location of the DCs. For this purpose, the biggest town in each county was identified as a candidate. These towns are likely to have the best infrastructure in the county; it would be close to the demand density and would probably have enough skilled labor to operate the DCs. Some changes were made to the locations after reviewing the candidates. The following changes were made:

- Moyale DC was moved to Marsabit;
- Mandera DC was moved to Takaba; and
- Ngong DC was moved to Kajiado.

Both Moyale and Mandera are towns situated on the border between Kenya and Somalia and security concerns were raised on having potential DCs there. Therefore, these DCs were moved to more southern parts of the respective counties. Ngong was moved to Kajiado due to being too close to the Nairobi DC.

Figure 14 depicts the final DC locations in every county. Forty-seven DCs were added for identified towns in every county. The town population data is provided for information purposes.

Figure 14: Proposed DC Locations in Every County

County	New County RDC Name	Town Population*
Nairobi	Nairobi	3 133 518
Mombasa	**Mombasa**	**936 131**
Kisumu	Kisumu	388 311
Nakuru	**Nakuru**	**307 990**
Uasin Gishu	Eldoret	289 380
Kiambu	**Ruiru**	**238 858**
Machakos	Kangundo-tala	216 557
Nyeri	**Nyeri**	**119 353**
Vihiga	Vihiga	118 696
Kilifi	**Malindi**	**118 265**
Garissa	Garissa	116 317
Kitui	**Kitui**	**109 588**
Trans Nzoia	Kitale	106 187
Kericho	**Kericho**	**101 808**
Kakamega	Mumias	99 987
Bungoma	**Kimilili**	**94 927**
Nandi	Kapsabet	86 803
Bomet	**Bomet**	**83 729**
Wajir	Wajir	82 800
Migori	**Rongo**	**82 088**
Kisii	Kisii	81 801
Nyandarua	**Ol kalou**	**66 015**
Kwale	Ukunda	62 529
Taita Taveta	**Wundanyi**	**62 404**
Embu	Embu	60 673
Homa Bay	**Homa Bay**	**58 936**
Meru	Meru	53 627
Busia	**Busia**	**51 981**
Turkana	Lodwar	48 316
Isiolo	**Isiolo**	**45 989**
Murang'a	Makuyu	44 007
Elgeyo Marakwet	**Iten/Tambach**	**42 312**
Nyamira	Nyamira	41 668
Narok	**Narok**	**38 653**
Laikipia	Nanyuki	38 198
West Pokot	Kapenguria	34 046
Siaya	**Bondo**	**33 488**
Baringo	Kabarnet	25 346
Kirinyaga	**Wanguru**	**23 983**
Mandera	Takaba	21 474
Lamu	**Lamu**	**16 362**
Tana River	Hola	17 337
Samburu	**Maralal**	**15 660**
Marsabit	Marsabit	14 907
Kajiado	**Kajiado**	**14 860**
Makueni	Wote	9 875
Tharaka Nithi	**Kathwana**	**Unknown**

* Kenya County Fact Sheets. Commission on Revenue Allocation. December 2011

Distribution center costs were assumed at KES 23,864,584 per annum for a 300 pallet DC and KES 31,819,445 per annum for a 600 pallet DC. Variable costs were assumed at KES 129,399 per m^3 throughput at the specific DC.

Two scenarios variations were analyzed within this scenario:

1. DC in every county (optimal facility allocations); and
2. DC in every county (forced county boundaries).

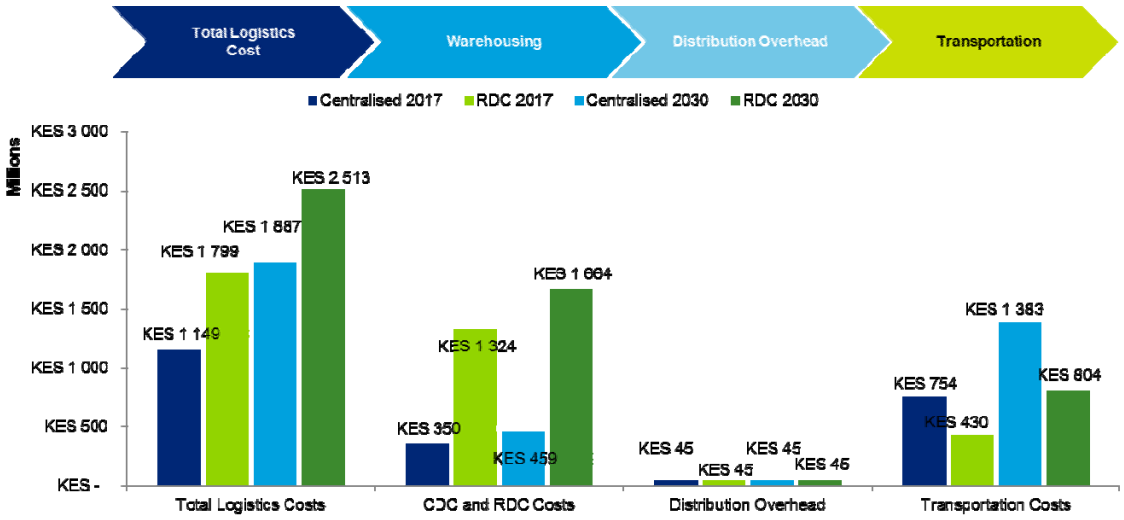
In the optimal facility allocation scenario variation county DCs were not restricted to deliver within their own county only. Deliveries to facilities were allowed to cross county borders in order to provide the most cost effective transport.

In the forced county boundaries scenario variation county DCs were only allowed to deliver within their own counties. This resulted in a sub-optimal solution from logistics costs point of view, but could make the management of county funds easier.

It was found that the forced boundaries deliveries scenario was 2-3% more expensive than the optimal deliveries scenario. This was mainly due to an increase of 8.4% in transport costs from KES 430 million (Figure 15) to KES 466 million (Figure 16).

In total, depending on the scenario variation (2017 vs. 2030 or optimal deliveries vs. forced boundaries), the DC in Every County scenario was also 33% to 60% more expensive than the Centralized DC scenario. While the DC in every county scenario's transport cost is much lower, the DC warehousing costs are higher, resulting in a much higher cost than the centralized strategy.

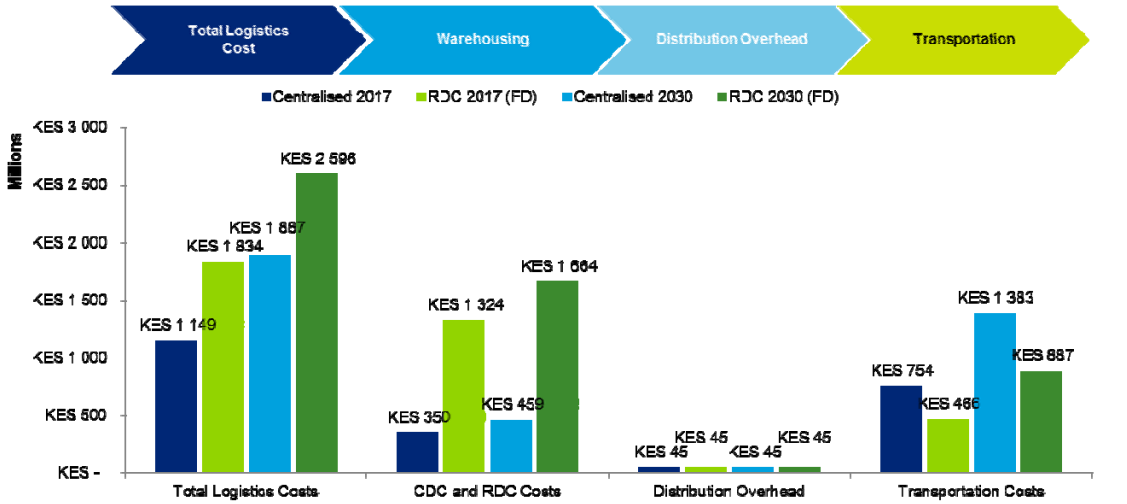
Figure 15: Centralized Network vs. DC in Every County – Optimal Delivery



Scenario	Cost / Volume	Total Logistics Costs	Warehouse & Depot Costs	Distribution Overhead	Transportation
Centralised 2017	KES/m³	KES 9 485	KES 2 892	KES 371	KES 6 221
RDC 2017	KES/m³	KES 14 846	KES 10 924	KES 371	KES 3 551
Centralised 2030	KES/m³	KES 7 300	KES 1 774	KES 174	KES 5 351
RDC 2030	KES/m³	KES 9 723	KES 6 439	KES 174	KES 3 109

Volume 2017: 121 164 m³
Volume 2030: 258 431 m³

Figure 16: Centralized Network vs. DC in Every County – Forced County Boundaries



Scenario	Cost / Volume	Total Logistics Costs	Warehouse & Depot Costs	Distribution Overhead	Transportation
Centralised 2017	KES/m³	KES 9 485	KES 2 892	KES 371	KES 6 221
RDC 2017 (FD)	KES/m³	KES 15 140	KES 10 924	KES 371	KES 3 845
Centralised 2030	KES/m³	KES 7 300	KES 1 774	KES 174	KES 5 351
RDC 2030 (FD)	KES/m³	KES 10 046	KES 6 439	KES 174	KES 3 432

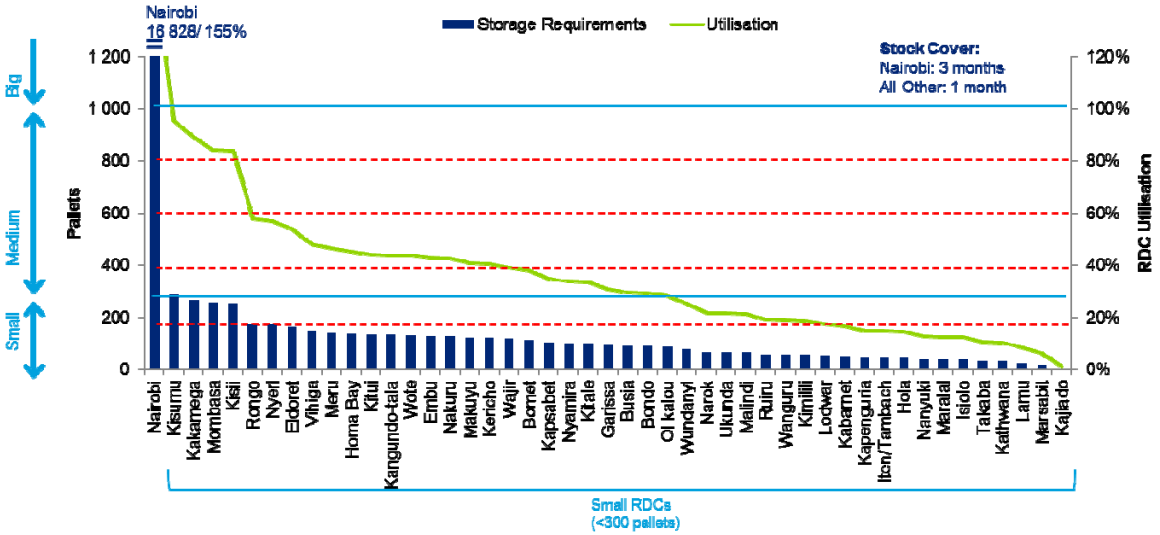
Volume 2017: 121 164 m³
Volume 2030: 258 431 m³

The DC in Every County Scenario for 2017 (forced boundaries) is 60% more expensive than the Centralized Distribution Scenario for 2017 (KES million 1 887 vs. KES 2 596 million). This means that if a DC in Every County Scenario were to be discussed for implementation, careful consideration needs to be applied when determining the policies for allocating facilities to specific county DCs. It may make more business sense to cluster counties together and build a DC for a group of counties where the optimal delivery route principal can be applied.

Concerning utilization, more than 80% (39 of the 47) of the DCs would be utilized 50% or less (Figure 17). Building DCs only becomes feasible if more than 50% of the storage space is utilized and additional, future growth in volume is a real possibility. Optimal utilization of DC warehouse space is around 80%. Another factor against building small DCs is the under-utilization of the vehicles doing the deliveries from these DCs. Although a 300 pallet warehouse size was selected for these scenarios, any warehouse size under 600 pallets should be questioned as the fixed costs including human resources to staff the DC will not yield the best return on investment.

Thus, having a DC in every county creates a lot of additional capacity which will not be utilized efficiently. The additional capacity also comes with increased complexity and a large amount of fixed operational costs, which is a high-risk approach. Utilization of 300 pallet DCs would be very low, with more than 80% of the DCs being less than 50% utilized.

Figure 17: 2017 Storage Requirements and Capacity Utilization for DC in Every County Scenario



3.2.6 Scenario 3: Optimal Distribution Center Locations

3.2.6.1 Analysis Overview

The initial step in determining the optimal network configurations was to perform a center of gravity analysis. A center of gravity analysis is designed to give an indication of where facilities should be located based on demand and/or supply, in order to minimize the total cost. The center of gravity analysis can also evaluate a large number of alternative strategies at a high level without having to configure all of the detailed logistics cost.

In order to do find the optimal locations, a demand file containing all KEMSA facility GPS locations and demand volume was applied to a network model containing 558 potential DC locations.

The central Nairobi DC was forced in the model as the main DC, while the other potential locations could be selected based on the lowest cost option. It is important to note here that the cost considered were only high-level costs and the model objectives were to minimize secondary distribution from the DCs. Primary distribution costs were not included in the center of gravity analysis. Detailed costing models were required to obtain a more realistic view of the projected costs and to validate the center of gravity analysis.

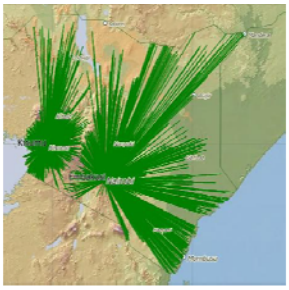
The model was forced to select a specific number of potential DCs from the 558 seed locations. The result from the center of gravity analysis would then propose the lowest cost locations for the specific number of DCs in the network. For example, if the model was forced to select two DCs, it would select Nairobi (since it was a forced DC location) and one other DC location (from the 558 seed locations) that would provide the lowest total cost in the network. Nine separate models were run – each one forcing the model to progressively add an additional DC to the network. The results of the center of gravity analysis are in Section 3.2.6.2.

After the optimal DC locations were identified, detailed costing models were run for the three DC scenario, five DC scenario and eight DC scenario. The financial cost assumptions are discussed in Section 3.2.6.3.

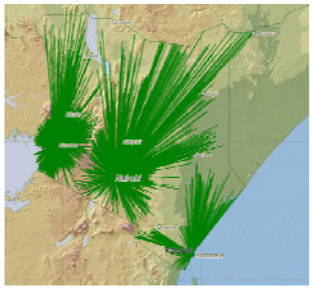
3.2.6.2 Findings

The results of this analysis are depicted in Figure 18. The DCs are listed in order of decreasing throughput. For example, in the nine DC scenario, Nairobi will have the biggest throughput and Buite would have the smallest. Figure 18 shows the center of gravity results for two to nine DC scenarios.

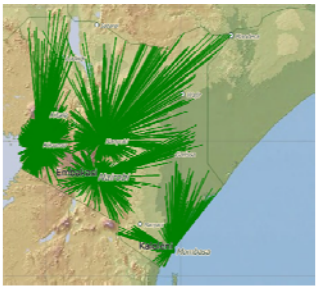
Figure 18: Summarized Results from Centre of Gravity Analysis



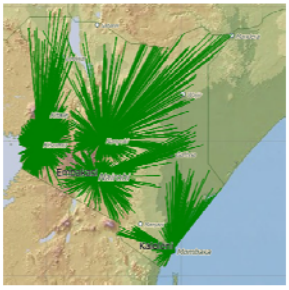
#	Distribution Centres
1	Nairobi
2	Kisumu



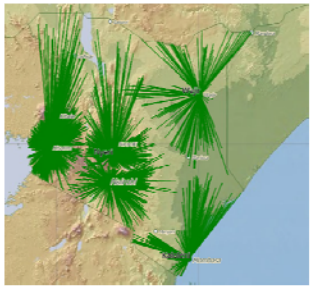
#	Distribution Centres
1	Nairobi
2	Kisumu
3	Kaloleni (near Mombasa)



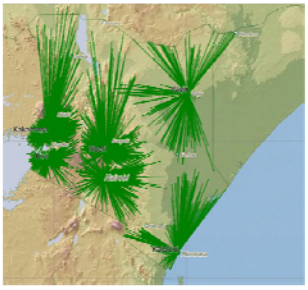
#	Distribution Centres
1	Nairobi
2	Kisumu
3	Nanyuki
4	Kaloleni (near Mombasa)



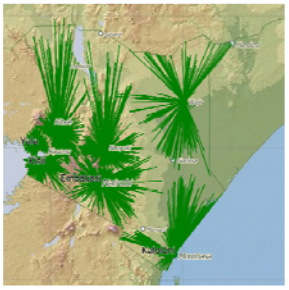
#	Distribution Centres
1	Nairobi
2	Kisumu
3	Nanyuki
4	Kaloleni (near Mombasa)



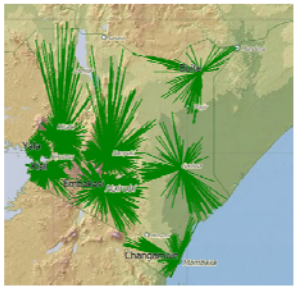
#	Distribution Centres
1	Nairobi
2	Kisumu
3	Nyeri
4	Kaloleni (near Mombasa)
5	Wajir



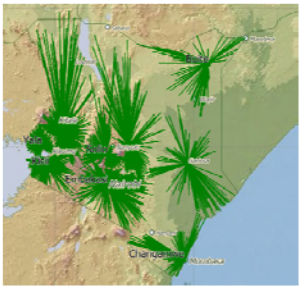
#	Distribution Centres
1	Nairobi
2	Kakamega
3	Nyeri
4	Kisii
5	Kaloleni (near Mombasa)
6	Wajir



#	Distribution Centres
1	Nairobi
2	Naro Moru (near Nyeri)
3	Yala
4	Kisii
5	Eldoret
6	Kaloleni (near Mombasa)
7	Wajir



#	Distribution Centres
1	Nairobi
2	Naro Moru (near Nyeri)
3	Yala
4	Kisii
5	Eldoret
6	Changamwe (near Mombasa)
7	Korokora (near Garissa)
8	Buite



#	Distribution Centres
1	Nairobi
2	Yala
3	Kisii
4	Solio (near Nyeri)
5	Eldoret
6	Changamwe (near Mombasa)
7	Meru
8	Korokora (near Garissa)
9	Buite

The following observations were made from the center of gravity analysis results:

- **Kisumu DC** – For the first five scenarios the first choice for adding a second DC to the network was Kisumu. The Kisumu DC remained an option until the model was forced to add a sixth DC. This suggested that, unless more than five DCs are envisaged for roll out, Kisumu would be a good candidate for a DC location.
- **Mombasa DC** – The model suggested locations close to Mombasa (within 35kms) namely Kaloleni and Changamwe (depending on the number of DCs in the model). These locations feature as a potential DC location from the three DC scenario throughout the rest of the scenarios.
- **DCs in Mount Kenya Area** – In the four DC scenario a DC is introduced at Nanyuki. In the five and six DC scenario with the introduction of Wajir, Nanyuki moves to Nyeri. In the seven to nine DC Scenario, the DC moves locations to Naro Moru and Solio – both which are close to Nyeri. In the nine DC scenario, Nyeri volumes are split off to Meru.
- **DCs in Eastern/North-Eastern Area** – In the five DC scenario, Wajir is introduced and remains as a DC until volumes are split in the eight and nine DC scenariso between Buite and Korokora (close to Garissa).

The following were key findings from the center of gravity analysis results:

- **Close Proximity to Existing Infrastructure** – Apart from Wajir and Buite, many of the DC locations suggested by the results were close to KEMSA's existing infrastructure.
    - Kisumu Area – Candidate locations in this area included Kisumu (1-5 DC scenarios), Yala (7-9 DC scenarios), Eldoret (7-9 DC scenarios) and Kakamega (6 DC scenario). KEMSA already has a depot in Kisumu, Kakamega and Eldoret. Kisii was the only suggestion where no KEMSA infrastructure exists.
    - Mombasa Area – Candidate locations included Kaloleni/Changamwe which are within 35kms from the Mombasa depot.
    - Mount Kenya Area – Suggested locations in the Mount Kenya area are close to either Meru or Nyeri (Naro Moru and Solio candidate locations) depots.
- **Consistency in Candidate Locations Indicated a Robust Implementation Path** – Up until the six DC scenario, adding more DCs to the network did not change any previous candidate locations. For example, Kisumu remained as a candidate DC until a sixth DC was introduced in the network. In this scenario the volume in the Kisumu area was split between Kakamega and Kisii. Thus, if five or less DCs are rolled out, the center of gravity analysis results indicates that Kisumu should be rolled out first, followed by Mombasa, Nyeri and then Wajir in that order. Since five DCs seem to be more than sufficient for a country of Kenya's size, the Kisumu location should remain a strong candidate.

3.2.6.3 Financials

As the center of gravity analysis does not take into account primary transportation costs and different individual DC operational costs, detailed costing models were required to confirm which scenario would be the most cost effective.

Warehouse cost assumptions made were based on the estimated size of the specific warehouse operations. The size was estimated based on throughput requirements of the warehouse and the specific inventory management policies. Different inventory management policies were assumed for Nairobi as opposed to

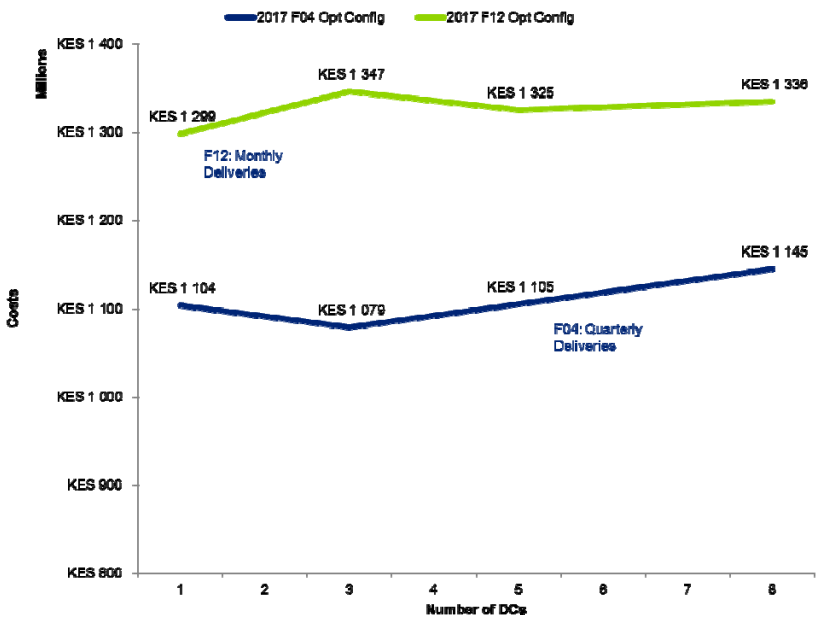
the regional DCs. For Nairobi two months' cycle stock and one month safety stock was assumed. For the regional DCs two weeks' cycle stock and two weeks' safety stock was assumed.

Primary transportation cost assumptions are the same as for the DC in Every County Scenario. For secondary transportation, co-loading of hospital, RHF and other types of facilities were allowed. Secondary transport cost assumptions were the same as for the DC in Every County Scenario.

We decided with KEMSA to model the three DC, five DC and eight DC scenarios in detail for both monthly and quarterly deliveries. Monthly deliveries were only modeled to indicate possible future trends.

Figure 19 depicts detailed network costing results for the optimal DC locations based on quarterly deliveries (which is the current state) for 2017 volumes. The quarterly delivery scenario results indicate that the three DC scenario is most cost effective. The monthly delivery scenario results indicate an increase in costs from Centralized to the three DC scenario followed by a decrease in costs in the five DC and eight DC scenarios. This can be attributed to less load consolidation for monthly versus quarterly distribution using the specific vehicle size configuration. Although the three DC scenario with monthly deliveries provides better load consolidation than the Centralized DC scenario, it is not enough to counter the increase in warehouse operational costs. Different vehicle parameter configurations could be investigated to further optimize the three DC scenario with monthly deliveries. As the monthly delivery scenario is not envisaged to be rolled out across all facilities in the near term, the three DC scenario assuming quarterly deliveries is deemed to be more optimal for immediate implementation.

Figure 19: Detailed Costing Results for Optimal DC Locations



3.2.7 Scenario 4: Rationalized Distribution Locations

3.2.7.1 Analysis Overview

Once the optimal DC locations were identified for the two to nine DC scenarios, the results were reviewed with KEMSA, and minor adjustments were made to the optimal DC locations and alternative locations proposed based on strategic factors. These factors include the consideration of existing infrastructure, security related issues and availability of skilled labor. Detailed costing models were developed to determine the impact of the rationalization decisions. Warehouse operating costs as well as the primary and secondary transport cost parameters were used to build the detailed costing models.

As many of the optimal DC locations were close to existing KEMSA infrastructure, optimal location suggestions were rationalized in the following way:

- **Kisumu Area** – In the case of the Kisumu suggested DC, the only rationalization that was required was moving Yala (7-9 DC scenarios) to Kisumu, as KEMSA already has a depot in Kisumu. In the 8-DC scenario the DC locations were rationalized by moving Yala to Kisumu, keeping Eldoret and Kisii and removing the Buite DC since the volume are low and would require a small DC that would be expensive to run. In addition, KEMSA does not have any existing DC infrastructure in the area and in general the area is subject to security concerns.
- **Mombasa Area** – The candidate locations Kaloleni/Changamwe needed to be rationalized to Mombasa, as the distance to the Mombasa depot is less than 35km.
- **Mount Kenya Area** – Suggested locations in the Mount Kenya area were rationalized to either Meru or Nyeri, based on Naro Moru and Solio candidate locations.
- **Eastern/North Eastern Area** – The Wajir/Buite suggested locations were rationalized to Garissa. This was mainly due to security concerns in the North Eastern parts of Kenya close to the Somali border.

Figure 20, Figure 21 and Figure 22 illustrate the delivery footprint for the three DC, five DC and eight DC scenarios.

Figure 20: Delivery Footprint for Rationalized Three DC Scenario

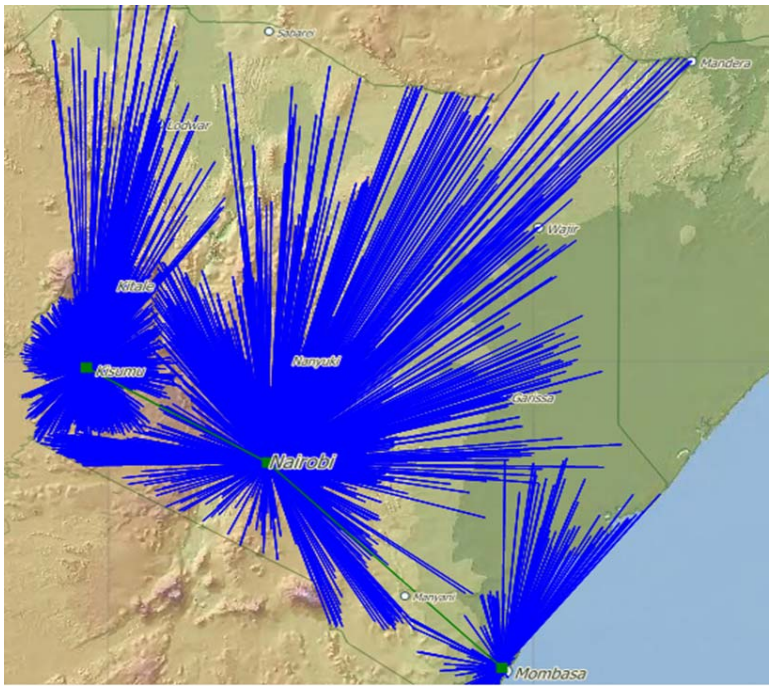


Figure 21: Delivery Footprint for Five DC Scenario

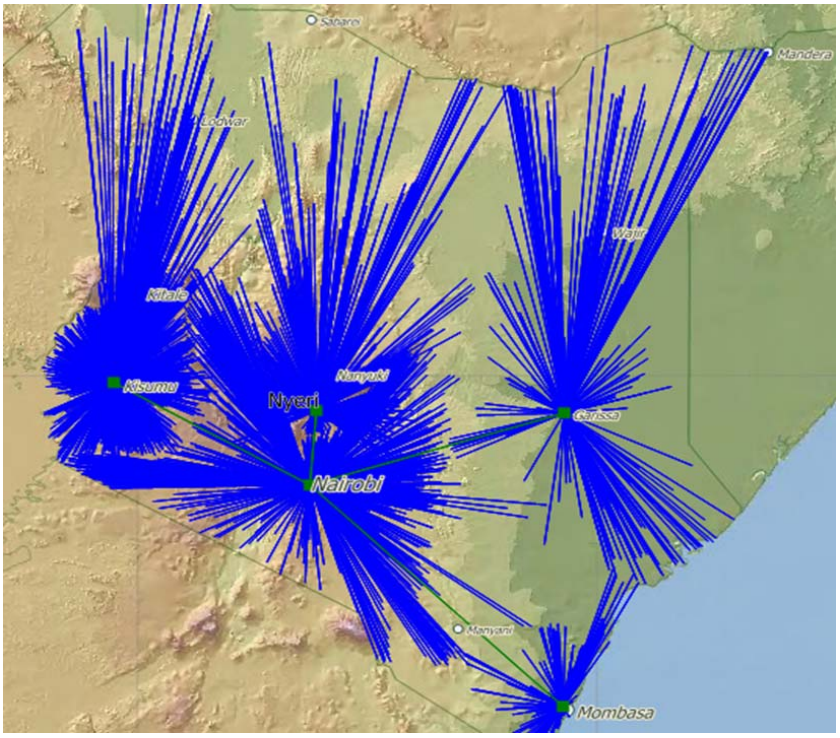
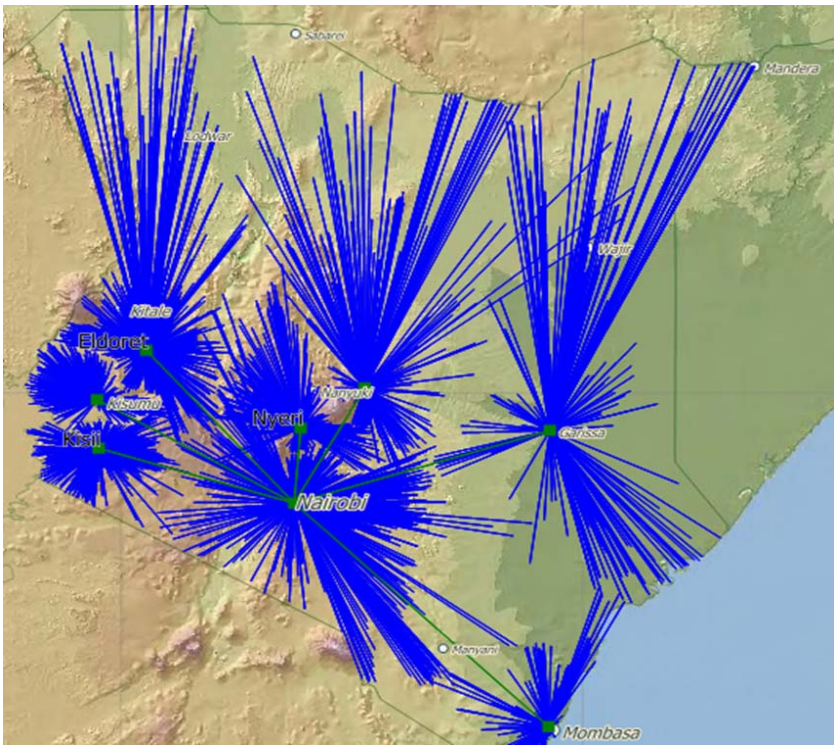


Figure 22: Delivery Footprint for Eight DC Scenario

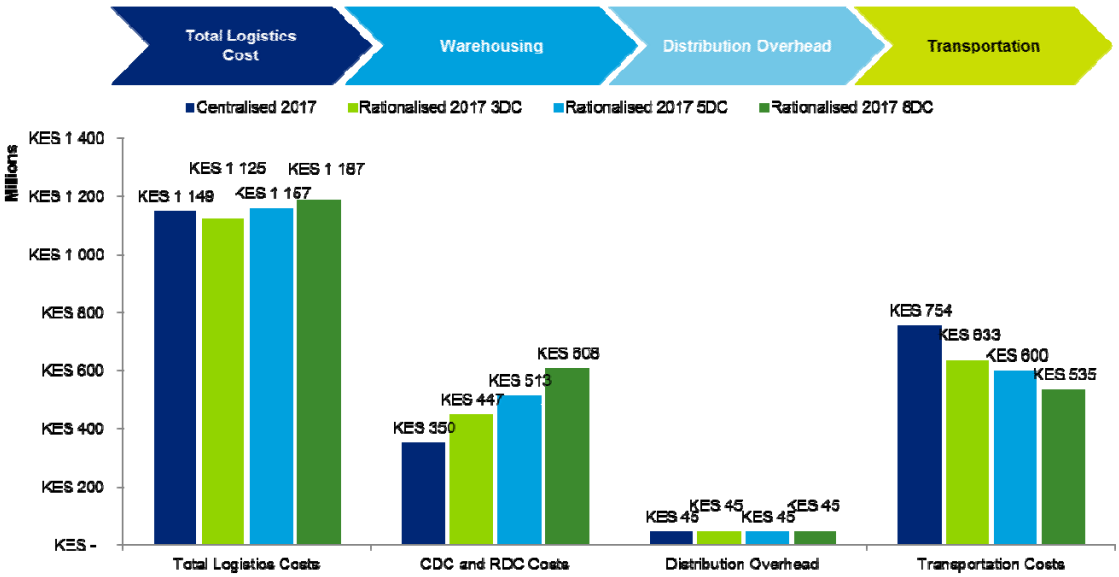


3.2.7.2 Financials

The detailed costing that was done for the rationalized eight DC scenario used a slightly different network configuration from the optimal eight DC scenario that was proposed by the center of gravity analysis. The nine DC suggested locations were used and changed to create the new eight DC scenario. Yala was moved to Kisumu due to close proximity to existing infrastructure. Buite was removed from the list due to relative low volumes, lack of existing infrastructure and security concerns in the north-eastern parts of Kenya.

Rationalized network configuration with quarterly deliveries using 2017 volumes indicates one to five DCs are optimal, with the best configuration being three DCs at KES 1,125 million. Figure 23 shows the detailed costing of the three DC scenario compared to the costing of the Centralized scenario.

Figure 23: Detailed Costing Comparing Three DC, Five DC and Eight DC Scenarios



Scenario	Cost / Volume	Total Logistics Costs	Warehouse & Depot Costs	Distribution Overhead	Transportation
Centralised 2017	KES/m³	KES 9 485	KES 2 892	KES 371	KES 6 221
Rationalised 2017 3DC	KES/m³	KES 9 283	KES 3 686	KES 371	KES 5 226
Rationalised 2017 5DC	KES/m³	KES 9 552	KES 4 233	KES 371	KES 3 012
Rationalised 2017 8DC	KES/m³	KES 9 800	KES 5 016	KES 371	KES 2 686

Volume 2017: 121 164 m³

For the purpose of comparison and simplification, the distribution overhead costs were kept the same across the scenarios.

Warehousing costs increase as new DCs are added to the network. For example, the annual DC costs for the Centralized Model for 2017 is estimated to be KES 350 million, and increase to KES 608 million for the eight DC scenario.

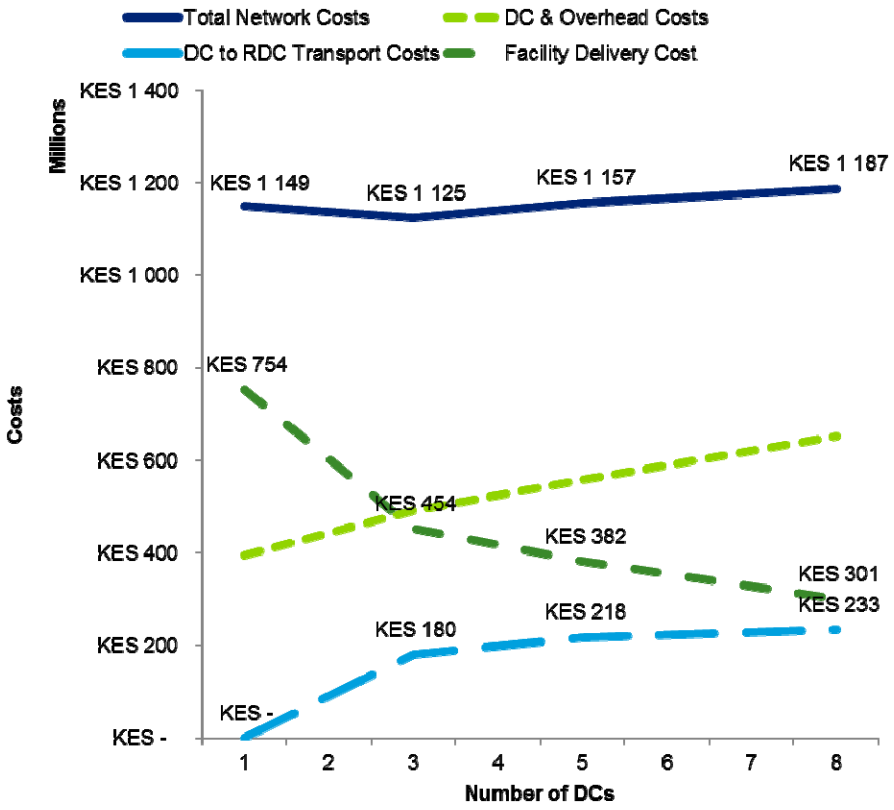
While the DC costs increase as new DCs are added to the network, transportation costs decrease. Transportation consists of primary transportation costs as well as secondary transportation costs. Primary transportation costs are the costs incurred to deliver from the centralized DC to the regional DCs. Secondary transportation costs represent the costs to deliver from a DC to the facilities.

Figure 24 illustrates how primary transportation costs increase and secondary transportation costs decrease when adding new DCs to the network. Primary transportation costs increase from a zero base in the one DC scenario (centralized network) to KES 180 million in the three DC scenario. In the one DC scenario there are no inter-DC transfers and all transportation is classified as secondary transport (delivering directly to facilities). Secondary transportation costs decrease due to the DCs being closer to the facilities. If the

primary costs increase is countered by the secondary cost decrease, the overall savings can counter the additional costs incurred by adding new DCs to the network.

In the three DC network the total logistics costs are less than the centralized network total logistics costs. This is because the transportation costs reduce more than the additional costs introduced by adding two regional DCs (Kisumu and Mombasa) to the network. Figure 24 shows the cost associated per DC. The graph highlights that the three DC scenario is most optimal in relation to cost.

Figure 24: Rationalized DC Scenarios Detailed Costs Components



3.2.7.3 Distribution Center Capacity Requirements

Based on the product flows, the Nairobi warehouse would store both primary and secondary distribution commodities. This would include two months' cycle stock (assuming deliveries from suppliers every two months) and one months' safety stock across all commodities.

In total, the regional DCs would require 30 days (one month) of stock cover. This would include two weeks' cycle stock (assuming replenishment every two weeks from the Nairobi warehouse) with the remaining stock cover being safety stock.

Table 5 provides the space requirements results for 2017 of the three DC, five DC and eight DC scenarios. Pallets space requirements were calculated based on a volume to pallet conversion factor of 1.8 m^3 per pallet. Adding more DCs results in an increase in the total network space requirements. A three DC scenario would require 18,058 pallet spaces throughout the network, whereas an eight DC scenario would require 18,658 pallet spaces.

Table 5: Rationalized Distribution Centre Space Requirements for 2017

Scenario	Distribution Center	Current Capacity (pallets)	Space Requirements (pallets)	Total Network Space Requirements (pallets)
3-DCs	Nairobi	9,200	15,422	18,058
	Kisumu	628	2,197	
	Mombasa	320	439	
5-DCs	Nairobi	9,200	14,937	18,484
	Kisumu	628	2,196	
	Nyeri	360	662	
	Mombasa	320	386	
	Garissa	72*	303	
8-DCs	Nairobi	9,200	14,736	18,658
	Kisumu	628	884	
	Kisii	0	821	
	Eldoret	360	747	
	Nyeri	360	472	
	Mombasa	320	386	
	Meru	72*	327	
	Garissa	72*	285	

*Estimated pallet sizes and not actual pallets measured

Nairobi's capacity requirements were adjusted to prevent duplication of safety stock in the network. Safety stock allowed for in the regional DCs was subtracted from the safety stock allowed for in Nairobi. The results of these adjustments are reflected in the reduction of space requirements at Nairobi from 15,422 pallet spaces in the three DC scenario to 14,736 pallet spaces in the eight DC scenario.

In the three DC scenario, Kisumu would require a significant expansion to 2,197 pallets spaces. Mombasa would require marginal expansion to 439 pallet spaces.

In the five DC scenario, Kisumu and Mombasa would require similar expansions as in the three DC scenario. Nyeri would need to expand to 662 pallet spaces. Garissa would need to expand to 303 pallet spaces.

In the eight DC scenario, Kisumu and Mombasa would require marginal expansions to 884 and 386 respectively. A new DC would be required in Kisii. Eldoret would need to double its pallet spaces to 747 pallet spaces. Nyeri would need marginal expansion to 472 pallet spaces. Meru and Garissa would need significant expansions to 327 and 285 pallets space respectively.

In the case where marginal expansion is required, the following measures could be investigated in order to reduce the space requirement and potentially eliminate the need to expand.

- **Review Regional DC Replenishment Policies** – Space requirements are determined based on 30 days' stock cover, including an allowance for replenishment every two weeks. By increasing the frequency of replenishments to the regional DCs, the cycle stock and safety stock requirements could be reduced and could therefore result in less space requirements.
- **Limit DCs to Only Serve RHFs** – Limiting the DCs to only serve RHFs could also reduce space requirements, as the RHFs require a lot less volume to be delivered from the DC. However, caution needs to be applied here, as this could result in a sub-optimal transport costs.

3.2.7.4 Optimal vs. Rationalized Locations

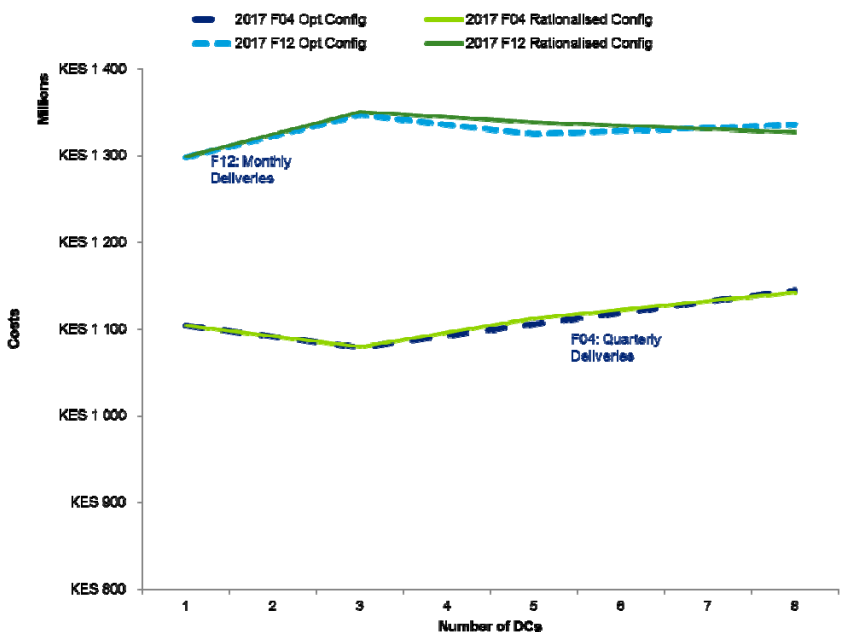
When rationalizing optimal network configurations it is important to understand the impact of doing this.

Figure 25 compares the costing of the optimal scenarios with the costing of the rationalized scenarios. Comparing optimal DC logistics network costs with the rationalized DC logistics costs indicates that there is not a significant difference between them.

The key finding here is that the maximum difference between the optimal and the rationalized network configuration is 0.63% (KES 6.9 million).

Bearing in mind the benefits of utilizing existing infrastructure and very similar service levels in terms of delivery reach, the difference is small enough (almost insignificant) and should not influence the decision to accept the changes proposed in the rationalization.

Figure 25: Total Network Costs: Optimal vs. Rationalized



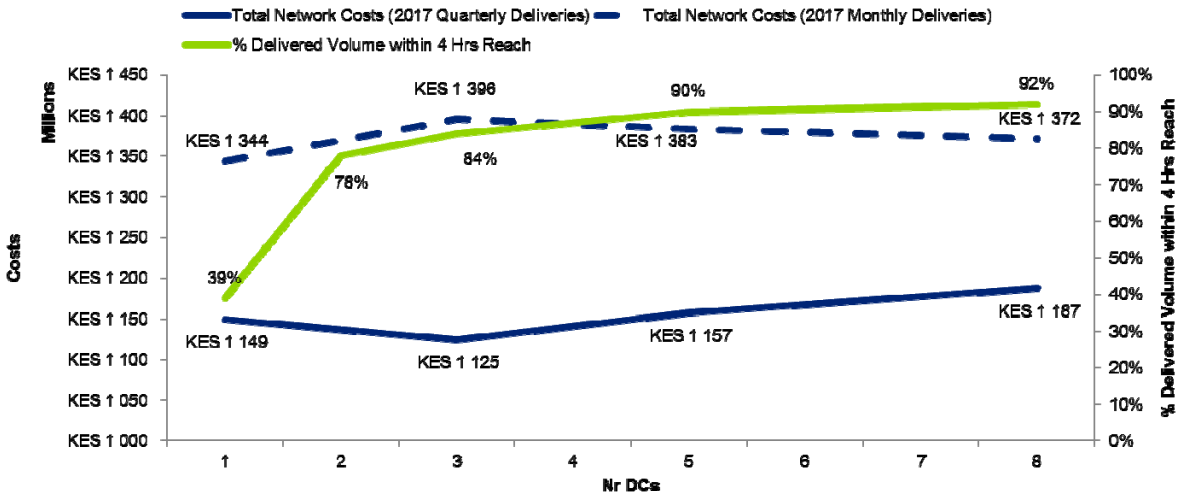
3.2.8 Cost vs. Service Levels

When determining the optimum number of DCs, it is important to not only consider the impact it has on costs, but also the responsiveness of the logistics network. A high responsiveness could improve customer service levels and affect key performance metrics like order lead-time. It will also improve KEMSA's ability to increase delivery frequencies to facilities where required.

The metric used here to determine supply chain responsiveness is the amount of delivered volume that is within four hours' reach of the DCs. This means a vehicle could depart from the DC, execute the deliveries and be back at the DC within one day. Volume that needs to be delivered beyond the four hours' reach would mean a possible overnight trip for the drivers and introduce additional complexity and delays in the transportation schedules and execution process.

In Figure 26, the projected 2017 total network costs were overlaid with the respective services levels that could be achieved in the specific scenario. This is key in determining what increase in service levels (percentage of volume that can be delivered within four hours' reach) KEMSA could get for adding additional DCs to the network. In the three DC scenario, the percentage of delivered volume that can be reached within 4 hours has increased from 39% to 84%. Concurrently, the total network costs have decreased by 2.1% (KES 24.4 million). This means that with the three DC scenario, KEMSA could achieve better responsiveness in the supply chain at a reduced annual operating cost. Figure 26 shows a comparison of the increase in DCs and the relative impacts on service level and cost.

Figure 26: Comparison of Increasing the Number of DCs on Service Level and Cost

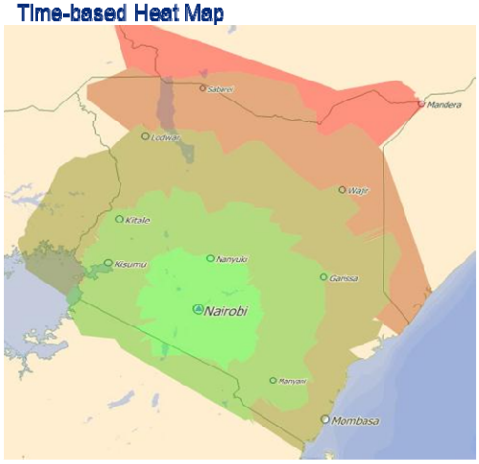


Adding more DCs in addition to the three (Nairobi, Kisumu and Mombasa) not only starts increasing total annual operating costs, but the network's responsiveness only marginally improves from 84% to 92% in the case of the eight DC scenario.

The heat maps in Figure 27 and Figure 28 illustrate the effect on the network's responsiveness (in time and distance). Figure 27 shows the current state impact (39% within 4 hours' reach) and Figure 28 shows the three DC impact (84% within 4 hours' reach).

Figure 27: Heat Map of the Responsiveness of the Current KEMSA Logistics Network

Time-based Heat Map



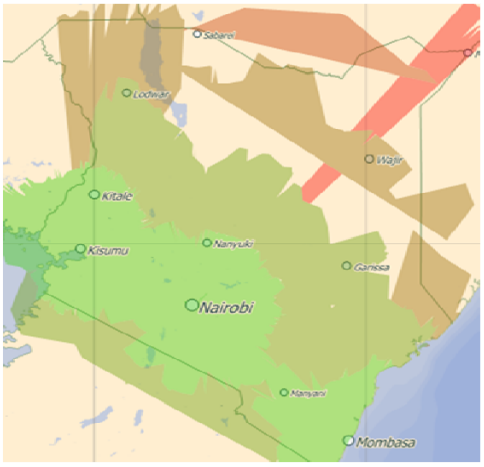
Delivery Lead Time	% Demand reached
4 Hours	39.4%
8 Hours	49.2%
12 Hours	9.2%
16 Hours	1.8%
20 Hours	0.5%

Distance-based Heat Map

Travel Distance	% Demand reached
202 kms	34.3%
404 kms	47.7%
606 kms	14.3%
808 kms	2.9%
1 010 kms	0.9%

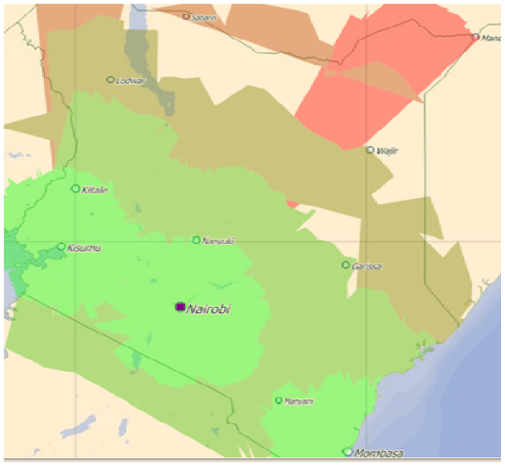
Figure 28: Heat Map of the Responsiveness of a 3-DC KEMSA Logistics Network

Time-based Heat Map



Delivery Lead Time	% Demand reached
4 Hours	83.7%
8 Hours	10.6%
12 Hours	4.0%
16 Hours	1.3%
20 Hours	0.5%

Distance-based Heat Map



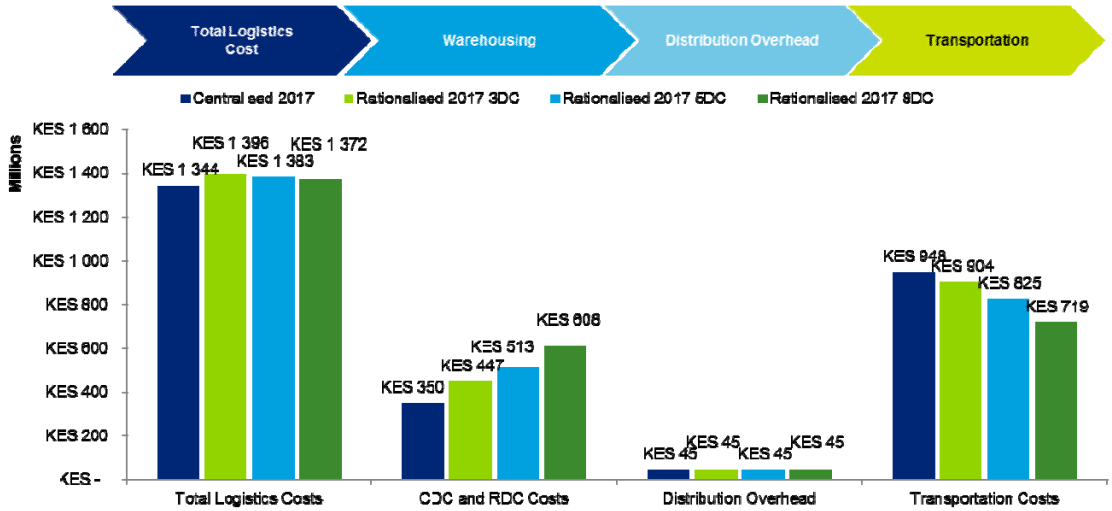
Distance	% Demand reached
202 kms	79.5%
404 kms	13.3%
606 kms	4.8%
808 kms	1.9%
1 010 kms	0.8%

3.2.8.1 Quarterly Deliveries vs. Monthly Deliveries

Although it is anticipated that KEMSA would increase their delivery frequencies to facilities, it is not anticipated that it would be required within the near term across the entire logistics network simultaneously. That said, this scenario was investigated in order to provide insight into future trends.

Figure 29 compares the centralized network costs with the three DC, five DC and eight DC scenarios assuming monthly deliveries. Total network cost comparisons indicate an increase in costs to the three DC scenario after which the costs start decreasing.

Figure 29: Detailed Costing Comparing Centralized DC, Three DC, Five DC and Eight DC Scenarios Assuming Monthly Deliveries



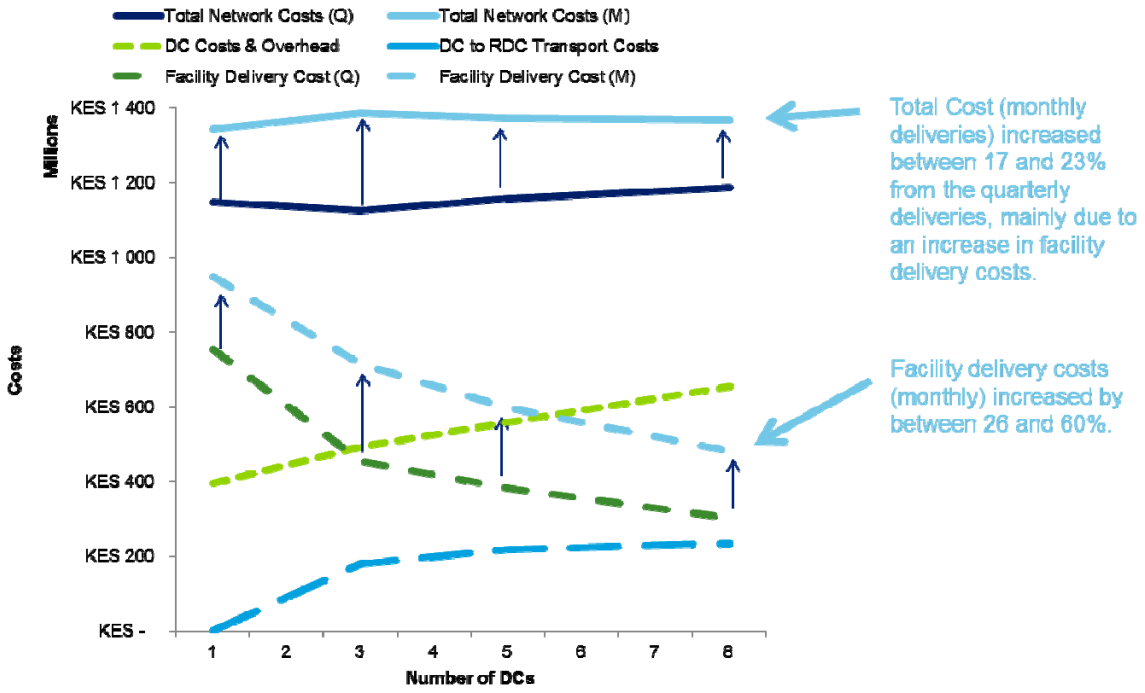
Scenario	Cost / Volume	Total Logistics Costs	Warehouse & Depot Costs	Distribution Overhead	Transportation
Centralised 2017	KES/m³	KES 11 091	KES 2 892	KES 371	KES 7 827
Rationalised 2017 3DC	KES/m³	KES 11 518	KES 3 689	KES 371	KES 7 458
Rationalised 2017 5DC	KES/m³	KES 11 418	KES 4 237	KES 371	KES 4 063
Rationalised 2017 8DC	KES/m³	KES 11 322	KES 5 017	KES 371	KES 3 540

Volume 2017: 121 164 m³

Changing delivery frequencies from quarterly to monthly, the total logistics network costs increase by 16% to 23%. This is mainly due to an increase in secondary transportation costs. Primary distribution costs have not changed. Secondary transportation costs have increased by 26% for the Centralized Distribution Scenario compared to the 58% increase for the Three DC Scenario. It must be noted that if an immediate move to more frequent deliveries such as monthly deliveries would be considered, the centralized distribution option will remain the most optimal cost efficiency solution for at least the next five years.

Figure 30 below shows that changing from quarterly to monthly deliveries increases costs, mainly due to the increase in secondary transport costs.

Figure 30: Increase in Costs due to Increase in Delivery Frequency



3.2.9 Distribution Center Roll-out Prioritization

The center of gravity analysis findings suggested a robust implementation path for up to five DCs in the network. Adding one DC at a time (up to five DCs) to the network did not significantly change any of the previous DC locations. From the rationalized DC locations scenario findings, the three DC scenario with Kisumu and Mombasa as regional DCs was deemed optimal. The question remaining was whether Kisumu or Mombasa should be rolled out first.

The center of gravity analysis revealed that by adding only one regional DC, Kisumu was selected. Adding another regional DC to the network (three DC scenario) suggested Mombasa as the third DC. This in itself suggested the sequence in which the DCs should be rolled out.

Supporting this finding was an analysis done on the responsiveness of the logistics network. By adding Kisumu first, 78% of delivered volume could be reached within 4 hours. Adding Mombasa as the third DC would only increase this figure to 84%. The greatest impact could therefore be achieved by first rolling out Kisumu.

3.2.10 Alternatives to Mombasa as the Third Distribution Center

3.2.10.1 Purpose

During the analysis it became apparent that Kisumu would definitely fit the requirements for the second DC. However, if there are potential concerns on whether current infrastructure at the Mombasa depot could appropriately be improved, alternative DC options can be considered. Some of these alternatives and their impact were investigated.

3.2.10.2 Assumptions

Six variations on the three DC scenario (Nairobi, Kisumu and Mombasa) were run. Each time Kisumu and Nairobi DCs were forced with an alternative DC. The alternative DCs were selected based upon locations where KEMSA already has existing infrastructure. This resulted in the following alternative DCs: Garissa, Meru, Eldoret, Nakuru, Nyeri and Kakamega.

The 2017 quarterly deliveries demand profile was used to do the detailed costing. The primary transport and secondary transport costs were the same as used in the DC in Every County Scenario.

3.2.10.3 Findings

Figure 31 compares the impact on cost and service levels between the alternative DCs. The DC costs exclude all overheads. Only annual DC operational costs are included. The transport costs include primary and secondary transportation costs. The cost comparison in Figure 31 indicates Mombasa as the most cost effective.

Figure 31: Cost and Service Level Comparison for the Third DC

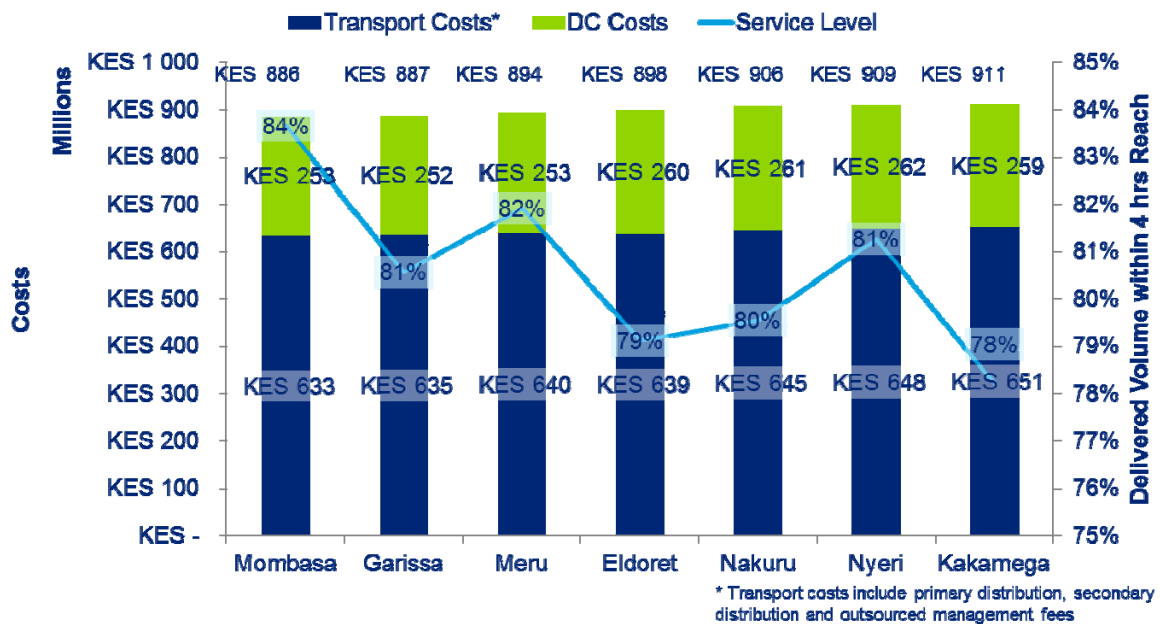


Figure 31

From Figure 31 the following observations can be made:

- The difference between the most cost effective (Mombasa at KES 886 million) and most costly (Kakamega at KES 911million) options are KES 24.8 million per year.
- DC costs for Mombasa, Garissa and Meru are roughly KES 7 million less than for Eldoret, Nakuru, Nyeri and Kakamega. This is because these DCs only require a 600 pallet warehouse each, whereas the others require a 1,000 pallet warehouse each.
- The transport costs difference between Mombasa (KES 633 million) and Kakamega (KES 651million) is KES 18.3million. After Mombasa, Garissa, Eldoret and Meru provides the least transport cost option.
- Excluding Mombasa, there is not much difference in the DC reach between the various DCs. The DC reaches range between 78% and 82%. After Mombasa, Meru, Garissa and Nyeri provide the best delivery service coverage.

From an existing infrastructure point of view, both Meru and Garissa can currently only accommodate 72 pallet spaces and would require additional warehouse expansion. Eldoret, Nakuru and Nyeri currently each have 360 pallets spaces. KEMSA also currently owns land in Nyeri. These options would therefore require less investment and could possibly be used in the near term until volume growth has reached critical levels.

From a geo-location point of view, Eldoret is only 120 kms from Kisumu. Having two DCs so close to each other is not good practice. This is supported by the fact that the DC delivery reach or responsiveness for the Eldoret option is of the lowest levels.

For the remaining potential DCs (Nakuru and Nyeri) the DC costs are similar. Transport costs for a Nyeri DC is slightly more (about KES 3 million) than for Nakuru DC. However, Nyeri provides a better delivery reach.

When considering the future DC footprint if four DCs or more were to be rolled out, a DC in the Mount Kenya area was suggested by the center of gravity analysis (i.e. either Meru or Nyeri).

The Meru scenario's DC operating costs are KES 9 million less than Nyeri. This is mainly because the Meru DC's running cost was based on a 600 pallet warehouse (actual requirements were 623 pallets) while the Nyeri DC's running cost was based on a 1,000 pallet warehouse (actual requirements were 823 pallets). This put the Nyeri DC in the next cost bracket although it only required 200 more pallet storage spaces. This means that although having a DC in Nyeri would cost more, the difference in size requirements are small. Nyeri would have more space for future expansion while Meru would be used to the maximum capacity. If Meru would be upgraded to a 1,000 pallet warehouse, the DC operating costs would be similar. When considering transport costs, the Meru scenario's transport costs is approximately KES 8 million per year less than the Nyeri scenario.

Therefore, considering operating costs, service levels and future DC footprint and assuming required investment is *not* a factor, Garissa, Meru or Nyeri would be ideal alternative options to Mombasa.

As the Nyeri DC already has 360 pallet spaces available, and Meru and Garissa only have 72 pallets spaces, Meru and Garissa would require more investment to develop into the required size. Given that KEMSA already owns the land in Nyeri, the Nyeri DC is the best alternative to the Mombasa DC.

3.2.11 Kisumu 2-DC Scenario

3.2.11.1 Purpose

The initial consideration is moving from one DC to two DCs. Figure 32 illustrates the delivery footprint for a Kisumu 2-DC scenario. While the 3-DC scenario provides 84% of delivered volume within 4 hours' reach, rolling out Kisumu only, KEMSA could already achieve 78% (refer Figure 33). It was therefore decided to do a detailed 2-DC scenario where Kisumu would be the second DC.

During the analysis it was also found that Kisumu would require a 2 000 plus pallet warehouse assuming 2017 demand projections. KEMSA wanted to know how the implementation can be phased starting with only the current infrastructure.

Figure 32: Delivery Footprint for Kisumu 2-DC Scenario

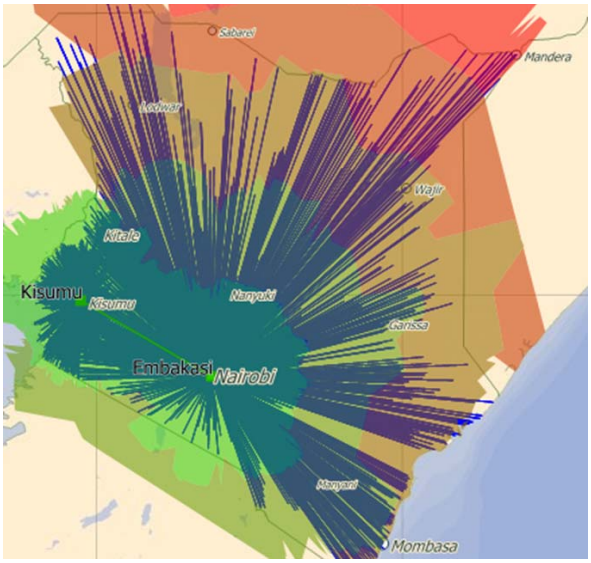
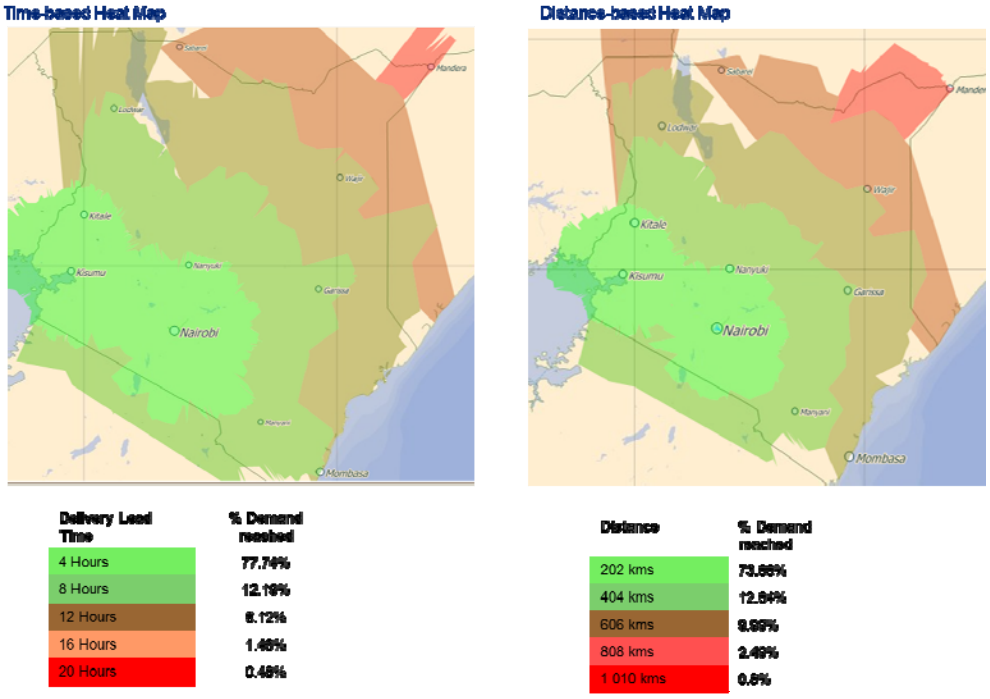


Figure 33 below shows that with the Two DC Scenario KEMSA could reach 78% delivered volume within 4 hours.

Figure 33: Heat Map of the Responsiveness of a Two DC KEMSA Supply Chain



3.2.11.2 Assumptions

We used quarterly deliveries for projected demand for 2017. The analysis indicated that Kisumu can be rolled out if deliveries from the Kisumu DC were limited to the counties listed in Table 6.

It was also decided to only do RHF deliveries from the Kisumu DC and all hospital deliveries (which formed the bulk of the delivered volume) would remain with the Nairobi DC. The same DC operational costs, vehicle configuration and vehicle cost assumptions were used as with the rationalized DC location scenarios.

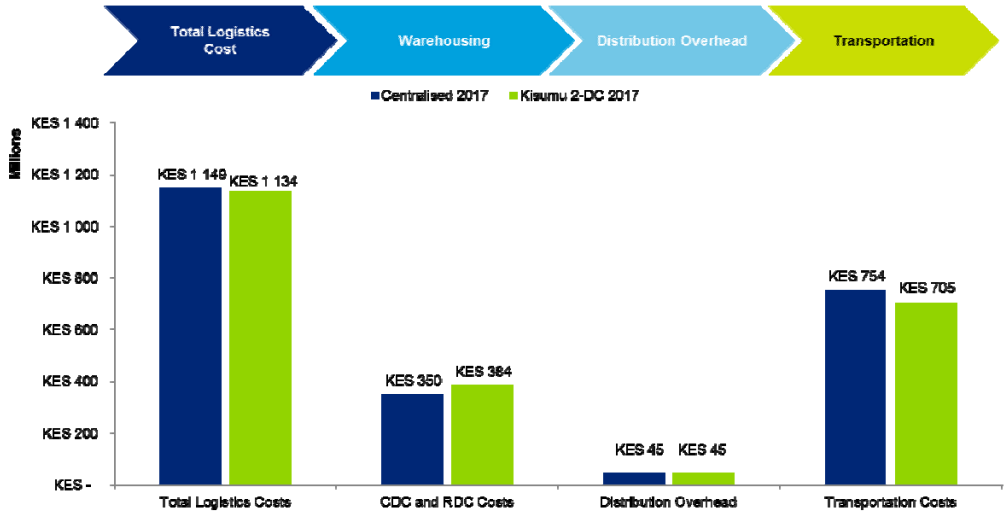
3.2.11.3 Findings

Figure 34 provides the detailed costing results for the Kisumu two DC scenario using 2017 demand projections. Total logistics costs reduced by 1.3%. CDC and RDC costs increased by 9.6% and transportation costs reduced by 6.5%. Secondary transport costs has decreased by KES 48.8m or 6.5% Figure 34 shows that rolling out Kisumu, with the current capacity, would marginally reduce costs.

Table 6: List of Counties Serviced by Kisumu

County	Volume Distributed (m^3)	% Total Volume
Kisumu	5 813	4.8%
Siaya	5 289	4.4%
Kakamega	5 081	4.2%
Homa Bay	4 910	4.1%
Kisii	4 833	4.0%
Migori	3 325	2.7%
Bungoma	3 019	2.5%
Busia	2 729	2.3%
Nandi	1 793	1.5%
Kericho	1 710	1.4%
Nyamira	1 644	1.4%
Vihiga	1 259	1.0%
Other Counties	79 758	65.8%
Total	**121 164**	**100.0%**

Figure 34: Total Logistics Network Cost for Kisumu Two DC Scenario



Scenario	Cost / Volume	Total Logistics Costs	Warehouse & Depot Costs	Distribution Overhead	Transportation
Centralised 2017	KES/m³	KES 9 485	KES 2 892	KES 371	KES 6 221
Kisumu 2-DC 2017	KES/m³	KES 9 359	KES 3 169	KES 371	KES 5 818

Volume 2017: 121 164 m³

3.2.12 Summary of Findings

The key findings with regards to the future state analyses are:

- A DC in every county would be 33% to 60% more expensive to run. The 33% refers to the best case scenario which is the DC in Every County 2030 – Optimal Deliveries scenario. The 60% refers to the worst case scenario, which is the DC in Every County 2017 – Forced Boundaries scenario.
- Three DCs, namely Nairobi, Kisumu and Mombasa, would provide the most optimal network configuration from a cost and service level perspective.
- By 2017, additional warehouse space would be required for the Nairobi, Kisumu and Mombasa DCs. If dead stocks are removed, appropriate inventory management principles are implemented and replenishment frequencies are reviewed, these required increases in storage space can be minimized.
- Rolling out Kisumu first would provide most value in the short term. Mombasa (or a feasible alternative) can be rolled out last.
- In the short term, Kisumu could be rolled out without major upgrading of the facilities, but would only be able to serve RHF facilities in selected surrounding counties. Hospitals would still be served from the centralized DC in Nairobi.
- Taking into consideration operating costs, required investment, potential service levels and the future DC implementation path, the most feasible alternative to a Mombasa DC would be a Nyeri DC.
- Rolling out Kisumu and Mombasa has a robust implementation path as they remain optimal, even if two additional DCs were added to the network.
- Additional DCs will add complexity to the network and careful consideration should be given to add beyond 3 DCs.

4 CONCLUSION

4.1 RECOMMENDATIONS

It is recommended that two additional DCs be implemented namely Kisumu and Mombasa. If it is determined during a detailed infrastructure feasibility study that Mombasa is deemed inappropriate, Nyeri should be the replacement DC. A DC in every county proves to be too costly and infrastructure would be under-utilized. Of the existing KEMSA depot list, Nakuru and Kakamega are not on the final scenario's list of recommended DC locations. We recommend that these depots be retained as KEMSA holding warehouses and regional offices.

It is recommended that, based on projected volume that could be realised up to and including 2017, that the current infrastructure at Nairobi, Kisumu and Mombasa be upgraded in order to handle the required volumes. This needs to be done in conjunction with a review of the procurement ordering and delivery policies and confirmation of replenishment policies to regional DCs to ensure warehouse space is utilised optimally. It should be noted that for the central warehouse, this analysis recommends a maximum of three months stock cover - two month's cycle stock (assuming deliveries from suppliers every two months) and one month's safety stock across all commodities. For the regional DCs 30 days (one month) of stock cover is recommended. This would include two weeks' cycle stock (assuming replenishment every two weeks from the Nairobi warehouse) with the remaining stock cover being safety stock. The current practises are not based on a maximum stock cover policy and will allow deliveries even if the stock cover is deemed sufficient which results in unnecessary consumption of warehouse space.

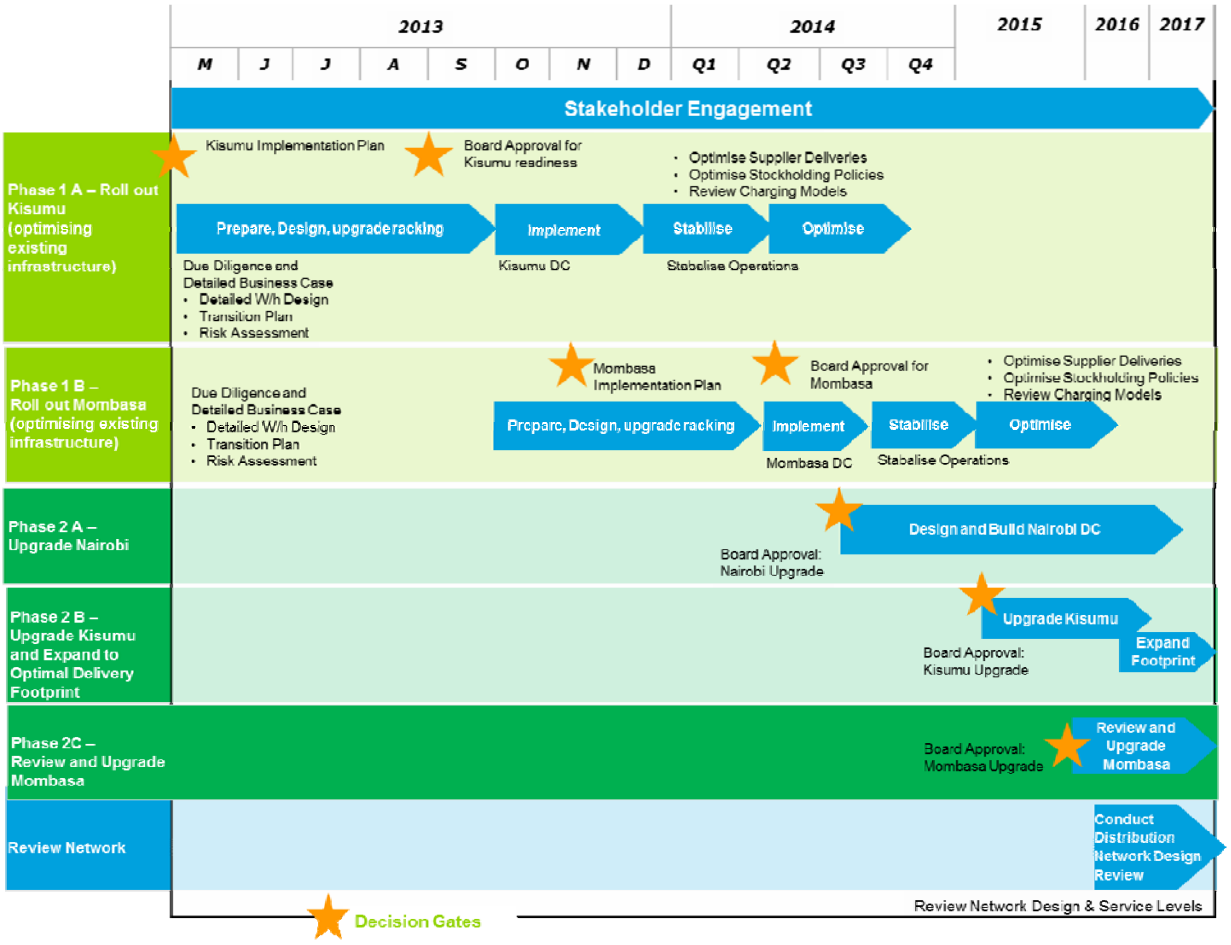
It is recommended that Kisumu be rolled out as the first regional DC. Current infrastructure would not allow for a complete roll-out. However, an interim distribution scenario has been modelled where the Kisumu DC would be able to serve only RHFs in selected surrounding counties using the existing infrastructure. This means that hospitals in the Kisumu delivery region would be served directly from Nairobi. Implementation of Kisumu can be followed by Mombasa or an appropriate alternative. It would be beneficial to improve storage conditions inside the depots before converting to DCs. This can be achieved through implementing racking and appropriate material handling equipment. It should be noted that if racking is to be implemented in the regional depots, roof extensions will be required. Racking will allow for additional storage capacity as well as more efficient receiving, storage and picking operations.

It is recommended that the implementation be phased to ensure it is manageable and that organizational learning is obtained with the roll-out of each additional distribution centre.

4.2 IMPLEMENTATION ROADMAP

Figure 35 outlines the proposed implementation path. Roof height extension and racking can be included in the first phase.

Figure 35: Proposed Implementation Path



The following phases are proposed:

- **Phase 1A** – We recommend roll out to Kisumu first using existing infrastructure and only distribute to RHF facilities from there. Extension of roof height and racking installation can be included in this phase. Current storage capacity (even with additional racking), would not be enough to distribute to hospitals. Hospital deliveries would still be serviced from Nairobi.
- **Phase 1B** – After Kisumu, we recommend roll out to Mombasa using existing infrastructure. Extension of roof height and racking installation can be included in this phase. If supplemental storage capacity in addition to Mombasa required we recommend using Nyeri. Extension of roof height and racking installation can be included in this phase to create additional capacity to supplement Mombasa.
- **Phase 2A** – Based on current projections, a bigger warehouse would be required in Nairobi to cater for increased throughput. This needs to be accompanied by a strategy to increase supplier delivery frequencies to ease warehouse space requirements in Nairobi. If supplier delivery frequencies are not increased, additional warehouse space would be required from the numbers mentioned in this report.
- **Phase 2B** – Based on current projections, a bigger warehouse would be required in Kisumu by 2017 to cater for increased throughput. This must be accompanied by a review of the replenishments policies to the Kisumu.
- **Phase 2C** – If extension of roof height and racking installation was completed in Phase 1 the Mombasa warehouse may need no further expansion. However, if direct shipments from suppliers directed to Mombasa are not routed via Nairobi, increased space will be required. A review of the Mombasa warehouse by the end of 2015 is required to ensure that capacity will be able to cater for increased throughput. This must be accompanied by a review of the replenishments policies to the Mombasa.
- **Phase 3** – We recommend a review of the network design in 2017 before deciding to add additional DCs. During this time the factors such as the delivery footprint and the make-up of the delivery frequency to facilities might have changed from current projections.