

Enhanced Visibility,  
Analytics and  
Improvement for  
the Mozambique  
Immunization  
Supply Chain

White Paper

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*VillageReach is a global health innovator that develops, tests, implements and scales new solutions to critical health system challenges in low-resource environments, with an emphasis on strengthening the "last mile" of healthcare delivery.*

[www.villagereach.org](http://www.villagereach.org) // [info@villagereach.org](mailto:info@villagereach.org)

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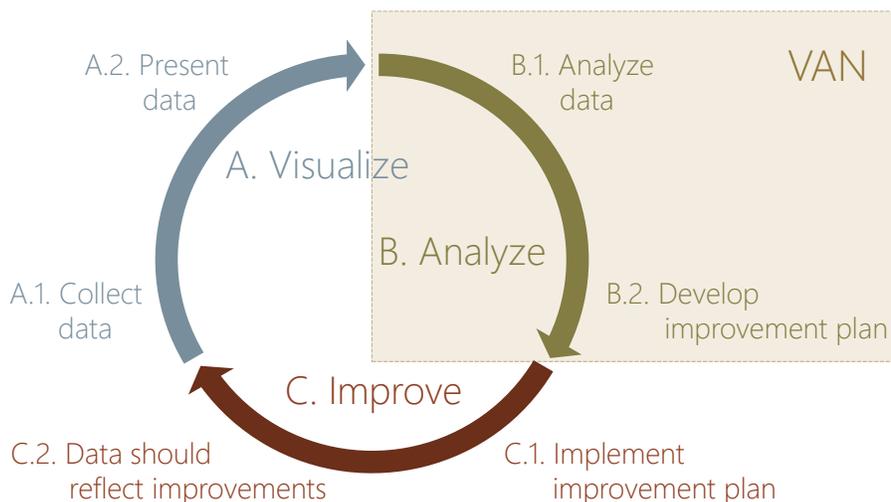
## Visibility & Analytics Networks: Key Concepts

The Visibility & Analytics Networks Project Blueprint Reference Model (VAN Reference Model) developed with the support of the Bill & Melinda Gates Foundation applies private sector supply chain management practices to public health supply chains with the objective of improving medical commodity availability. The VAN Reference Model describes three key supply chain management activities:

- A. *Visualize*. The first activity collects and then presents data regarding the performance of the supply chain. The goal of this activity is to provide end-to-end visibility across the entire supply chain of what happens and how well it happens. The visualization of data is most useful when it includes alerts that highlight areas requiring attention.
- B. *Analyze*. Once the supply chain performance data can be seen, the second activity analyzes the data regarding how well the supply chain is functioning and then develops an improvement plan containing a set of recommended changes designed to improve supply chain performance.
- C. *Improve*. The third activity implements the improvement plan which, as it is implemented, should cause changes in the data.

Each of these activities are performed on a regular and continuous schedule (e.g., monthly, weekly) to establish a cyclical process of continuous improvement of supply chain operations. For example, implementation of this month's improvement plan should cause positive changes in supply chain performance and associated data, which in turn, will be collected, presented, analyzed and acted upon in the next cycle.

People, processes, technology and policy must be organized and aligned from the national level all the way to the service delivery level for these activities to occur as envisioned. Given the breadth and complexity of this requirement, the VAN Reference Model identifies a set of key tasks, primarily in the analysis segment of the cycle, that are most effectively performed by a small, well-coordinated group of highly-skilled supply chain professionals. The VAN Reference Model refers to this functional group as the "Visibility & Analytics Network" or "VAN" (usually referred to in private sector supply chains as a "control tower"). The VAN is responsible for ongoing analysis of supply chain performance data and, based on those analyses, recommending a series of ongoing improvements to enhance supply chain performance. The diagram shows VAN Reference Model activity cycle and the subset of those activities normally performed by the VAN (highlighted in the box).



This white paper describes how the VAN Reference Model can be applied to enhance the management and performance of Mozambique’s immunization supply chain for the purpose of improving vaccine availability, potency and supply chain cost efficiency. To apply the VAN Reference Model in Mozambique, it is first important to understand how Mozambique’s immunization supply chain and its related information system currently operates, then identify what changes are necessary to implement a VAN, or at least the VAN principles.

## Current Mozambique Context

Mozambique’s Expanded Program for Immunization (EPI, or in Portuguese *Programa Alargado de Vacinação* or PAV) is administered and implemented by the Ministry of Health (*Ministério de Saúde* or MISAU) at the national level, state health authorities in 11 provinces (*Direcção Provincial de Saúde* or DPS),<sup>1</sup> local health authorities in 148 districts (*Direcção Distrital de Saúde, Mulher e Acção Social* or district) and health workers at the ~1,350 health facilities across the country that provide immunization services (service delivery level/point). Mozambique’s immunization program follows the traditional EPI model for immunization supply chain and associated information system across all provinces, with some exceptions in certain provinces as described below. The following provides a brief “as is” description.

## PAV Standard Operating Model

Mozambique’s immunization supply chain has four levels which correspond to the three governmental administrative levels and a service delivery level. The following table provides a high-level overview of how responsibilities are allocated by policy (although not always in practice) among the four levels in the PAV standard operating model for:

- demand planning;
- supply planning and inventory management;
- distribution/transport management; and
- cold chain management.

Demand Planning	National	Province	District	Service Delivery Point
Determine program policies/targets for vaccines included in PAV, coverage, wastage, distribution, cold chain capacity	✓			

<sup>1</sup> There are 10 provinces and one capital city, Maputo, which has provincial status. Because Maputo city’s immunization supply chain is structured differently from the other 10 provinces, this white paper will focus primarily on the 10 provinces.

Develop annual forecast of vaccine inventory required based on national demographic survey and consumption information made available by lower levels during the past year	✓			
Review annual forecast of vaccine inventory and adjust based on local knowledge of past consumption		✓	✓	
Procure vaccines based on annual forecast	✓			
Prepare annual coverage report based on the ratio of vaccines given vs. the total target population (based on demographics information)	✓			
Report quarterly consumption (number of vaccines given for various age groups and wastage) aggregated by province		✓		
Report monthly consumption aggregated by district			✓	
Report monthly consumption by service delivery point				✓
Supply Planning, Inventory Management	National	Province	District	Service Delivery Point
Set target inventory levels for the year to be held at each storage location based on annual forecast	✓			
Receive vaccines as they enter country and manage inventory at national store	✓			
Manage inventory at provincial store; order replenishment quarterly based on target inventory minus inventory on hand		✓		
Manage inventory at district store; order replenishment monthly based on target inventory minus inventory on hand			✓	

Manage inventory at service delivery point; order replenishment monthly based on target inventory minus inventory on hand				✓
Distribution/Transportation Management	National	Province	District	Service Delivery Point
Distribute vaccine inventory on a quarterly basis from national store to each province to maintain target inventory levels for each province	✓			
Manage and fund transportation resources for national to province segment	✓			
Distribute vaccine inventory on a monthly basis from provincial level to each district to maintain target inventory levels for each district		✓		
Manage and fund transportation resources for province to district segment		✓		
Distribute vaccine inventory on a monthly basis to each service delivery point to maintain target inventory levels for each service delivery point			✓	
Manage and fund transportation resources for district to service delivery point segment			✓	
Cold Chain Management	National	Province	District	Service Delivery Point
Determine countrywide cold chain equipment requirements and procure	✓			
Monitor, maintain and repair cold chain at national store	✓			

Monitor, maintain and repair cold chain at provincial store		✓		
Monitor and maintain cold chain at district store <sup>2</sup>		✓	✓	
Report monthly cold chain temperature excursions and break downs to province			✓	
Monitor and maintain cold chain at service delivery point <sup>2</sup>		✓	✓	✓
Report monthly cold chain temperature excursions and break downs to district				✓
Repair cold chain at district store and service delivery point <sup>2</sup>		✓		

### Key Differences between PAV Standard Operating Model and VAN Principles

First, the PAV standard operating model is largely policy driven and implemented through an annual plan. Public sector workers are expected to follow the policies and annual plan currently in effect. Course corrections to the annual plan are considered and made as needed for the subsequent annual plan. Policy changes occur on a much longer timeline, especially since many national policies are tied to international EPI policies. In contrast, the VAN Reference Model uses a more fluid approach that adjusts based on what is or isn't working at the service delivery level as evidenced by an ongoing stream of data. A VAN would add a small group of highly skilled workers who are encouraged to make or recommend adjustments based on the data as and when they deem appropriate.

Second, given the size and breadth of governmental entities, responsibility is segmented and broken into various levels. For example, MISAU is only responsible for moving commodities from the national level to the provincial level. While a MISAU official can recommend policies and guidelines for province-level activities, he/she does not have the operational authority to require province-level employees to follow those policies nor the ability to hold them accountable if they don't. The PAV standard operating model reflects this type of compartmentalization, while the VAN Reference Model contemplates an operational approach that is integrated top-to-bottom.

### PAV Information System and Related Tools

The PAV information system is designed to generate data for the purpose of developing each annual plan and determining whether the plan's objectives are met. Because the system's purpose is to report up rather than manage day-to-day operations, data is aggregated as it flows up through the system. This approach then limits visibility for the higher levels back down to specific districts and service delivery points and does not provide information feedback loops for the lower levels.

<sup>2</sup> At each level local workers will perform some cold chain monitoring and preventive maintenance. There is one cold chain maintenance technician at the provincial level for each province who is responsible for all cold chain monitoring, maintenance and repair above what can be performed by local workers.

The system is heavily oriented toward the collection of programmatic data (e.g., number of vaccines given to various age groups, dropout rates, fully vaccinated totals). Programmatic data starts with the child health card and facility immunization register. Statistical data from the register is reported each month by the service delivery point to its district. Each district then consolidates the data reported by its service delivery points into a monthly report which is sent to the province. Each province consolidates the data and provides a monthly report to the national level. This reporting system is paper-based at the service delivery level and most of the district level. The data is captured and reported digitally at the provincial and national level in Mozambique's automated health statistics information system, a series of Access databases called *Modulo Basico*.

The PAV information system does collect some immunization supply chain and cold chain information. At the lower levels, some of this supply chain and cold chain information is collected on the monthly reports from the service delivery and district levels. Additional supply chain information is collected in the monthly order forms and proof of delivery logs. Some cold chain information is captured in connection with maintenance repairs. Supply chain information is automated at the national and provincial levels using multiple instances of WHO's Excel-based Stock Management Tool (SMT). There has been an effort, but with very limited success, to implement WHO's Excel-based District Vaccine Data Management Tool (DVDMT) at the district level.<sup>3</sup> At all other districts and all service delivery points the information system is paper-based.

### Dedicated Logistics System Operating Model

Since 2002, VillageReach has worked with Mozambique health authorities to develop and implement a new model to manage and operate the immunization supply chain and related cold chain. The new model, called the Dedicated Logistics System (DLS) in Mozambique and generically referred to as informed push, reflects the key VAN principles: visualize, analyze and improve accomplished largely through a small team of highly trained supply chain professionals. From the provincial level down to the service delivery point, the DLS alters the people, process, technology, and policy elements of the PAV standard operating model to achieve many of the benefits contemplated in the VAN Reference Model. The DPS in four provinces (and soon to be six provinces)<sup>4</sup> currently operate the DLS as an alternative to many parts of the PAV standard operating model.

The primary difference between the DLS and the PAV standard operating model is the consolidation of most supply chain and cold chain responsibilities across an entire province in a small team of government workers called "Field Coordinators." They operate from the provincial level but visit the districts and service delivery points each month to perform supply chain, cold chain and data collection tasks which would normally be assigned to district and service delivery point personnel in the PAV standard operating model. The differences in responsibilities are reflected in the table below (with differences from the PAV standard operating model highlighted in red):

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<sup>3</sup> Six provinces and 89 districts have been trained to use DVDMT, but many are having difficulty implementing the spreadsheet due to the need to use what becomes a very large file (>20MB) on old computers and having to transmit the file to the provinces when only limited communications bandwidth is available.

<sup>4</sup> The four provinces current operating the DLS are Gaza, Maputo, Niassa and Cabo Delgado. Two additional provinces, Tete and Manica, are preparing to implement the DLS. A seventh province, Inhembane, has recently expressed strong interest in the DLS and requested a visit to Gaza province to see the system in operation.

Demand Planning	National	Province	District	Service Delivery Point
Determine program policies/targets for vaccines included in PAV, coverage, wastage, distribution, cold chain capacity	✓			
Develop annual forecast of vaccine inventory required based on national demographic survey and consumption information made available by lower levels during the past year	✓			
Review annual forecast of vaccine inventory and adjust based on local knowledge of past consumption		✓	✓	
Procure vaccines based on annual forecast	✓			
Prepare annual coverage report based on the ratio of vaccines given vs. the total target population (based on demographics information)	✓			
Report quarterly consumption (number of vaccines given for various age groups and wastage) <del>aggregated</del> by province		✓		
Report monthly consumption <del>aggregated</del> by district		✓		
Report monthly consumption by service delivery point		✓		
Supply Planning, Inventory Management	National	Province	District	Service Delivery Point
Set target inventory levels for the year to be held at each storage location based on annual forecast	✓			
Receive vaccines as they enter country and store in national store	✓			

Manage inventory at provincial store; order replenishment quarterly based on target inventory minus inventory on hand		✓		
Manage inventory (buffer stock only) at district store; order replenishment monthly based on target inventory minus inventory on hand adjusted based on consumption		✓		
Manage inventory at service delivery point; order replenishment monthly based on target inventory minus inventory on hand adjusted based on consumption		✓		
Distribution/Transportation Management	National	Province	District	Service Delivery Point
Distribute vaccine inventory on a quarterly basis from national store to each of the provinces to maintain target inventory levels for each province	✓			
Manage and fund transportation resources for national to province segment	✓			
Distribute vaccine inventory on a monthly basis from provincial level to maintain appropriate buffer stock inventory levels for that district		✓		
Distribute vaccine inventory on a monthly basis to each service delivery level to maintain appropriate inventory levels for that service delivery point		✓		
Manage and fund transportation resources for province to district and district to service delivery point segments		✓		

Cold Chain Management	National	Province	District	Service Delivery Point
Determine countrywide cold chain equipment requirements and procure	✓			
Monitor, maintain and repair cold chain at national store	✓			
Monitor, maintain and repair cold chain at provincial store		✓		
Monitor and maintain cold chain at district store <sup>5</sup>		✓	✓	
<del>Report monthly cold chain temperature excursions and break downs to province<sup>6</sup></del>			<del>✓</del>	
Monitor and maintain cold chain at service delivery point <sup>5</sup>		✓		✓
<del>Report monthly cold chain temperature excursions and break downs to district<sup>6</sup></del>				<del>✓</del>
Repair cold chain at district store and service delivery point <sup>5</sup>		✓		

### Similarities between DLS and VAN Principles

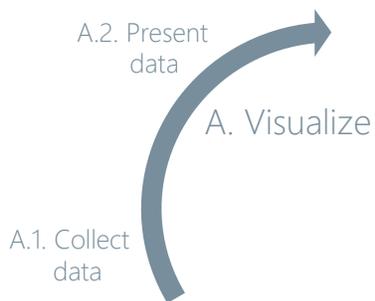
The DLS and related information system have been designed to make the immunization supply chain and cold chain operations within a province visible all the way to the service delivery point. By consolidating responsibilities for managing supply chain/cold chain operations across a province in a small group of highly trained Field Coordinators and their managers, data collection, analysis of the data and formulation of improvement plans occur on a routine basis. The Field Coordinators are then responsible for execution of the improvement plans. In effect, the Field Coordinators and their managers operate as a provincial-level VAN in that they analyze data and develop improvement plans on monthly basis.

<sup>5</sup> At each level local workers will perform some cold chain monitoring and preventive maintenance. There is one cold chain maintenance technician at the provincial level for each province who is responsible for all cold chain monitoring, maintenance and repair above what can be performed by local workers.

<sup>6</sup> Provinces that have deployed ColdTrace real time cold chain monitors do not require the district and service delivery point workers to report cold chain breakdowns since the Field Coordinators and provincial cold chain technician can remotely monitor the cold chain. The ColdTrace system is being expanded to three provinces.

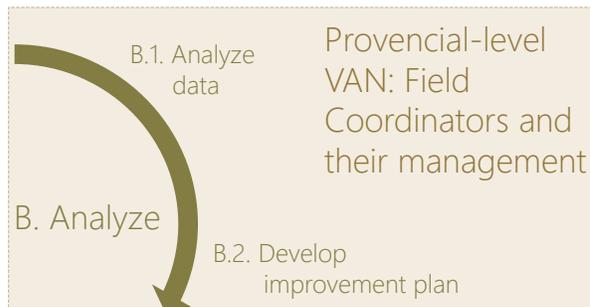
## DLS Information System and Related Tools

Data collection responsibilities at the district and service delivery level are shifted to the Field Coordinators. This approach improves data quality with the Field Coordinators triangulating from different data sources to confirm validity, comparing actual stock on hand with stock records, and providing immediate feedback to health workers on data quality. Using a tablet running *Sistema Electrónica de Logísticas de Vacinas* (SELV), an implementation of OpenLMIS, directly at the service delivery points and districts, also improves data availability at the provincial and national levels with relatively real-time data from the service delivery point.



For data visualization, SELV provides an analytical function in the monthly reports. The visualizations provide root cause analysis for determining follow-on actions to improve supply chain management. This approach streamlines the process to collect on the relevant data points.

The next step for the DLS information system is the systemized process for data analysis and utilization. After each monthly distribution, participatory follow-up sessions are held where the Field Coordinators review the dashboard with the provincial PAV manager, medical chief, and logistics supervisor. With this monthly review of the dashboard and alerts, the team can identify bottlenecks and ways to improve subsequent distribution activities. Additionally, this review process and analytical capacity of this team enables the Field Coordinators to check against previous deliveries and consumption data to find gaps in data that may not have been recorded by the health workers during the month.



The final step in the cycle is for the Field Coordinators to implement their improvement plan during next month's distribution/service visits to their respective districts and service delivery points.

During the process of refining the reporting requirements for SELV, improving data visualization and use, MISAU has been engaged to identify ways to complement their reporting needs at the national level. Seeing the functionality of the DLS and SELV and the decisions that are being made at the provincial level to improve supply chain management has generated substantial interest at the national level and highlighted the significant lack of visibility into the supply chain in other provinces where the DLS is not operating. The standard PAV information system with its aggregated, paper-based data cannot provide visibility into the true functioning of the supply chain all the way to the service delivery level nor support the analysis required to enable continuous improvement.

## Identified Gaps and Constraints

Through the Logistics Technical Working Group at the national level and the DPSs, VillageReach has worked closely with stakeholders to identify constraints with the current information system and the

processes and people that support it. The level of visibility available in the DLS provinces has highlighted the data gaps and weak processes in other provinces. This recognition has generated interest to address the gaps in PAV by introducing a cycle of visualizing, analyzing, and improving across the entire program.

## People

At every level of the system, the people component presents a significant gap in terms of quality and quantity. One PAV logistician at the national level is responsible for managing distribution and inventory, receiving reports, creating procurement plans, and providing on-going monitoring for improvement. The PAV national level monitoring and evaluation officers do not consider logistics data but focus mostly on programmatic indicators of coverage rates. There are many missed opportunities to utilize available data without a dedicated person and system to facilitate that process.

The same personnel constraints exist at the provincial level, in both DLS and non-DLS provinces. The PAV chief works with a logistician for vaccine distribution activities, but performance data is managed in a separate department. Lack of resources, capacity and time prohibit the PAV chief from taking a deeper analytical look into the functioning of the supply chain, how it affects and is affected by other factors, and how the poor data collected can negatively influence the bigger picture activities of procurement for the country. As the responsible entity for transport management, the provincial level faces constraints with equipment, lack of maintenance plans, and faulty financial flows delaying distribution plans.

The overburdened health worker at the facility level is also a known constraint to the overall functioning of the system, particularly in the non-DLS provinces. Requiring extensive data collection, stock management, and cold chain maintenance from a health worker trained to provide clinical care leads to poor quality of data and gaps in data collection from the service delivery level. As this data is aggregated up the echelons, the already poor quality only gets worse. These constraints are somewhat relieved in DLS provinces where dedicated logisticians more extensively support the data collect/management and logistics of the supply chain.

The deeper analysis provided by a fully functioning VAN requires VAN personnel to analyze the data coming in and drive action based on that data. Currently in Mozambique, this responsibility, especially in non-DLS provinces, is diffused among many people throughout the levels, none of whom have time to dedicate toward a continuous improvement practice.

## Process

Standard processes and procedures are key to effective supply chain management. Processes for data collection and analysis are established in Mozambique, yet they are minimally followed or adhered to for various reasons. For example, standard operating procedures (SOPs) are out of date or unknown; accountability measures are not adequately enforced; requirements of collecting a significant amount of data points coupled with the fact that healthcare workers are overburdened lead to poor quality data being collected; or the system is not designed to promote action-driven data analysis. There are few incentives for workers to follow the SOPs and little to no accountability for failure to follow them.

Any strong system should be driven by key performance indicators (KPIs) based on quality data which drive action for continuous improvement. In Mozambique, the KPIs most likely to be available (although with questionable quality) and tracked with interest are linked to program performance and vaccine coverage rate. Particularly in non-DLS provinces, little attention is paid to KPIs related to logistics, and

there is no standardized process to bring the two data sets together. Processes that are in place are reactive to annual reports instead of proactive to monthly review processes where change could be immediately implemented then followed up to see if a positive change has occurred.

Current processes and practices lead to a gap in data points and data quality. The root of this problem begins at health centers where stock cards are not routinely completed, monthly summary reports have egregious errors, and wastage rates are unknown. The twice-a-day temperature monitoring form for the cold chain is notoriously poorly completed, providing no true insight into cold chain uptime, temperature excursions, or potential problems with vaccine potency. Without any quality control process in place, decisions are made based on antidotes and/or unreliable information. Like the people component, this situation affects the supply chain for demand planning, inventory management, and procurement at each level, particularly for the national level forecasting activities. The DLS structure addresses many, but not all, of these constraints by providing more streamlined data collection and processes, using remote temperature monitoring devices for the cold chain, and facilitating monthly review and analysis of KPIs.

The lack of processes for feedback loops restricts data utilization efforts. As is often the case in a government paper-based system, data is sent up the chain of command, but little feedback or analysis is provided back down through the various levels. It is a missed opportunity for improvement in management of the supply chain and the immunization program in general. Health centers send in monthly requisitions, but the stock received may not match the request and no information is provided as to why. Conversely, plans for cold chain equipment distribution are made at the national level often based on out-of-date information. In the end, the distribution of the equipment gets changed to match the true needs, but information is not updated at the national level.

### Technology

The current information systems are fraught with problems, beyond the data quality issues. From a usability standpoint, the many systems – SMT, DVDMT, *Modulo Basico*, surveillance data, procurement plans, and inventory management systems – are not easy to use with each one tracking multiple data points that slow the system, do not easily correct errors, and provide no analytical capability. MISAU and stakeholders have expressed dissatisfaction with these systems especially when comparing with a modern, web-based system such as SELV.

The other issue with the many different information systems is the lack of a unified connecting point of all systems. Each system operates individually, leading to a duplication of efforts in many cases and missed opportunities for data analysis that could lead to system improvements. A person must consult several different spreadsheets and dashboards to get a full picture of the system.

Similar to the process component, no systematic feedback loops are built into the technology element of the system. Information flows up the levels but not down. Procurement plans are made but not revised as more accurate data is not available. Requisitions are made mechanically based on the annual plan for monthly stock for health facilities but are not verified against actual need. And stockouts or overstocking may be reported but little follow-up is done to understand the root causes of the stockouts or overstocking.

The final key concern of MISAU is the lack of visibility into the lower levels or “last mile” in the PAV standard operating model, especially given the high level of district and service delivery level visibility available in the DLS provinces. The current system aggregates data as it goes up the administrative

tiers. As such, national level PAV decision makers do not have a clear understanding of problems at the last mile. The responsibility to resolve those problems still lies with the lower administrative levels; however, in the absence of national-level visibility, little attention is paid to the priority problems.

### Policy

MISAU sets the policies for the immunization program and associated immunization supply chain for the entire country. The provinces, districts and service delivery points are expected to follow the policies. These policies reflect international EPI policies set by WHO and have remained largely unchanged, especially for immunization supply chain, since the initiation of the EPI over 35 years ago. While these policies were very appropriate at the time given the new ground being covered, they are inadequate today for an immunization supply chain which is asked to reach *all* children and handle the more expensive and logistically complicated new vaccines.

For example, the forecast method used to determine the amount of vaccines to be procured and distributed to each immunization post on an annual basis was appropriate 35 years ago when the EPI started distributing inexpensive vaccines where none had previously been available, but cannot meet current requirements. As noted above, Mozambique develops an annual forecast and inventory distribution plan utilizing a demographics-based formula recommended by WHO which must utilize the only available population numbers that are often inaccurate. Vaccine inventory is then distributed to provinces, districts and service delivery points during the year through a forced-ordering maximum/minimum control system. Non-DLS provinces compute an order amount based on the annual plan. In contrast, the Field Coordinators in the DLS provinces make adjustments each month to the annual distribution plan (and policy) based on their regularly updated knowledge of consumption patterns in the service delivery points they serve. As a result, during 2014, the DLS provinces delivered 10-40% less vaccines than mandated by the annual distribution plan, yet managed stockouts to <3% and avoided substantial vaccine wastage.<sup>7</sup> By analyzing routine data collected from the service delivery level, the Field Coordinators are managing down both stockouts and wastage, an achievement that is becoming essential as new, more expensive vaccines are introduced.

## Overall Framework

Mozambique is primed for a new approach that would implement VAN principles and a VAN. National-level interest in SELV and the visibility it provides all the way to the service delivery level is complemented by the growing national-level interest in system design and how the DLS operates not only to improve data collection but also improve effectiveness and efficiency in the supply chain. Additionally, the most recent EVM highlighted many areas for improvement, including data management, better stock management and reports on distribution, and improved policies and practices to eliminate stockouts and overstocking. These elements are also key components of the Gavi Health Systems Strengthening grant, expected to start this year, none of which can be accomplished without improved end-to-end visibility of the supply chain.

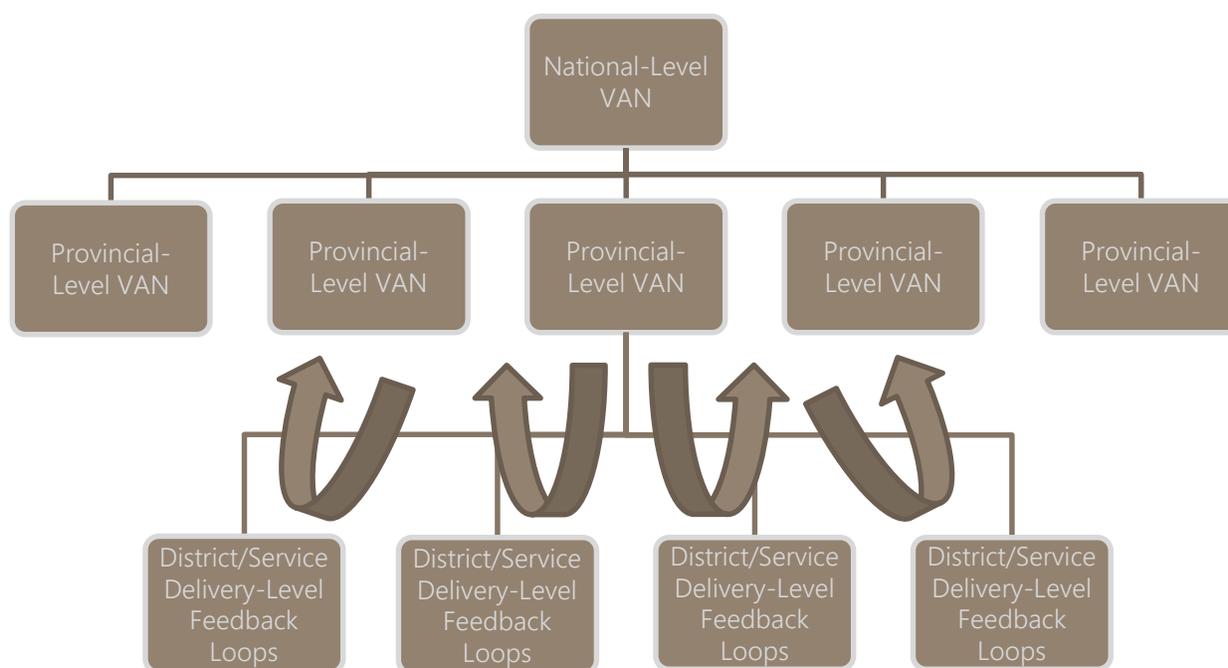
Much of the VAN work will focus on strengthening and expanding many of the people and processes that are already in place through the DLS and existing systems, and enhancing the technology component of SELV to build on and bring together existing systems. The DLS has made significant gains in improvement of the supply chain through improved data collection, interactive data

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<sup>7</sup> See [DLS Performance Report \(2014\)](#).

visualization and clear processes for data review leading to action for continuous improvement. These improvements have been noted at the national level by MISAU, which is interested in expanding these efforts to other provinces and establishing a national-level VAN. Because of decentralization policies and resulting allocation of administrative authority across various administrative levels within the government of Mozambique, the Mozambique VAN will need to operate as a coordinated collection of VANs at the national- and provincial-levels. The Mozambique VAN will pull data from all existing sources to create one unified vision to drive coordinated action. To be implemented successfully, it will require a fundamental change in how and why data is collected, used and analyzed.

Based on the identified needs and gaps at each level of the system, Mozambique will have a national-level VAN, provincial-level sub-VANs, and strengthened feedback loops to the district and service delivery levels. People, processes and technology will be strengthened at each level as appropriate. A coordinated and skilled team or VAN will lead the efforts for data analytics and drive continuous improvement at the national level and will closely coordinate to support the same efforts at the provincial level. Processes for data analysis will be systematized across all levels. And the current technology solutions will be enhanced to bring visibility into other provinces and to draw data from the many different existing sources to provide additional analytical possibility.



This work will take a phased approach, recognizing that much can be fine-tuned in the current system to improve data analytics and utilization, and even more can be done in later phases to change and replace information systems and processes to reduce the current manual requirements to pull data together. Each of the DLS provinces are already essentially running a mini-VAN which will be strengthened and systematized through these efforts. Establishing provincial-level VANs in other provinces will be phased, as more provinces adopt streamlined supply chains and interest is generated at the national level for improved data visibility across the country.

Another area for longer-term planning is the possibility of integrating vaccines, and subsequently the VAN work, into the Central Medical Stores (CMS) supply chain. Integration of the immunization supply chain is part of the long-term strategy of the CMS; there are processes and technologies that could be set in place now through this VAN work to prepare and be equipped for integration.

It will be important to clarify the responsibilities of each VAN and the governance structure. Many responsibilities of the national and provincial VANs will be similar but with a different level of focus for the different levels of the supply chain. The national-level VAN will serve a technical advisor role to the provinces, providing further analytical capabilities and providing the overall country-level view that is necessary to prioritize proper planning and establish a nationally coordinated approach. The specific roles and responsibilities of the national VANs and provincial VANs, as well as, the roles and responsibilities of the individuals within each VAN, will need to be worked out with MISAU and the DPSs during the planning and proposal stage of this project. Prior to those discussions, introducing the specificity of the roles and responsibilities as outlined in the VAN Reference Model would be speculative. The following table provides a high-level starting point:

#### Governance Structure and Responsibilities of the VAN

National	Provincial
<b>Members</b>	
EPI Chief, EPI Logistician, M&E Officer, UNICEF, WHO, VillageReach, seconded Technical Advisor	EPI provincial chief, EPI Provincial Logistician, Field Coordinators (DLS provinces), Medical Chief, CC technician, supported by the national-level Technical Advisor, and VillageReach Field Officer
<b>General Responsibilities</b>	
Review monthly reports of logistics, consumption, cold chain monitoring, disease surveillance, and financial flow to identify roadblocks to implementation; provide root cause analysis; and provide recommendations for improvements.	
Based on quarterly reviews, monitor the overall functioning of the supply chain, and identify poorly performing provinces for priority action	Based on monthly reviews, monitor the overall functioning of the supply chain, and identify poorly performing districts and health facilities for priority action
Provide technical assistance to provincial VANs	Coordinate with national VAN to report on key issues and identify solutions
<b>Demand Planning</b>	
Prepare annual procurement plans	Complete quarterly requisitions for vaccines based on increased visibility into stock needs for province
<b>Supply Planning, Inventory Management</b>	
Coordinate any restocking needs between provinces in case of over or under stock	Coordinate any restocking needs between districts in case of over or under stock

Evaluate warehouse capacity for in-bound and out-bound stock	Evaluate cold chain capacity for in-bound and out-bound stock (including outreach)
Distribution/Transportation Management	
Manage distribution and transport from national to provincial level	Manage distribution and transport from provincial to district and service delivery levels
Cold Chain Management	
Monitor cold chain equipment data for planning future procurement needs based on equipment functionality and vaccine program changes	Monitor daily cold chain equipment functioning to ensure health workers are responding to automatic alerts for immediate action; organize maintenance for corrective actions

## Key Principles

*Clear Vision, Incremental Improvement.* SELV is currently providing visibility into the functioning of the supply chain because it is part of an overall system that is designed to provide visibility through dedicated logisticians and direct data collection from health centers. The same cannot immediately be expected in other provinces without redesigning the PAV standard operating model. A phased approach can focus on certain areas that will improve data availability immediately, moving into a future replacement of SMT and DVDMT through a later phase of this VAN work.

*People and Processes.* Key components of any supply chain are the people and processes that ensure data is collected, commodities are distributed, policies are being followed, and vaccines are always available at health facilities. The DLS has already established processes for

monthly data review and analysis with a feedback loop for immediate action for the following month's distribution. As the VAN expands, these processes will be more systematic, particularly at the national and provincial levels where decisions can be made to improve the functioning of the supply chain.

*Build MISAU, DPS and District Capacity.* This work will build the capacity of MISAU, DPSs and districts to institutionalize the VAN throughout the country, building on the DLS, SELV and the processes already established in four (soon to be six) provinces. A seconded technical advisor will be placed in MISAU to focus on data review and analysis, looking across different data sets for best analytics and transferring skills to identified personnel at national and provincial levels. This manual process of analyzing data is the first phase as the technology is enhanced to integrate all data sets automatically in further phases.

*Ease of Use.* With an increased focus on data analytics and action-driven feedback, improvements to SELV will focus on the ease of use of the technology through streamlined reporting, enhanced tablet capability for immediate review of data, and clarity on accountability systems.

Clear Vision,  
Incremental  
Improvement

People & Processes

Build MISAU  
Capacity

Ease of Use

## Strategic Interventions

### People

The people component will drive the processes and use of technology for biggest impact. Currently, VillageReach, CHAI and UNICEF have been providing technical assistance to MISAU on logistics and supply chain management. This technical assistance has only touched the surface of data utilization to drive decisions and usually only at the higher decision-making levels. For a strong VAN, MISAU recognizes the need for increased human resources and analytical capability to lead continuous improvement efforts. The proposed activities include:

1. *Build internal capacity at MISAU and DPSs to manage the activity cycle of a VAN.* This work begins at data collection and goes through data analysis, developing and implementing an improvement plan, and confirming results based on further data analysis. It is divided into two categories:
  - *Seconded technical advisor to MISAU.* A technical advisor will be seconded to MISAU to provide on-going capacity building for data analytics and utilization. As a data analyst, this technical advisor will drive the systematic data review processes and provide the same guidance to the provincial level to ensure proper data review, analysis, and evidence-based decisions. National-level efforts will have a particular focus on the end-to-end supply chain in order to improve forecasting and procurement plans for the country. The provincial level efforts will have a greater focus on immediate changes that can be made to the supply chain to ensure monthly distributions are reliable, efficient, and are based on proper planning. This technical advisor will work to ensure key personnel are responding to alerts generated by the enhanced technology systems.
  - *More directed technical assistance provided to MISAU.* VillageReach has learned a great deal through the process of developing and deploying the DLS and SELV. After many years of field testing with proven results, MISAU is now ready to apply this learning nationwide. VillageReach will work with MISAU, the Logistics Technical Working Group, and the seconded technical advisor to institute changes in how MISAU should analyze and use data.
2. *Increase capacity to improve efficiencies in transport optimization.* Through exchanges and technical assistance from eHealth Africa, provincial-level staff will be better equipped to manage transportation with a constant driving for efficiencies. eHealth Africa will provide technology (based on what is currently used in Nigeria) to identify and implement efficiencies in the transportation system. Transportation managers will be able to track KPIs related to cost, driver performance, and asset management thus enabling the formation of a distribution performance management plan to improve efficiencies through continuous improvement

### Process

Processes for data collection, analysis and utilization need to be clarified at each level of the system to build accountability measures and expectations of high performance. The proposed activities include:

1. *Systematic monthly reviews of logistics data.* A key task will be to create systematic and documented reviews of monthly logistics reports, drawing from the existing information systems available. This process has been started with SELV in four provinces with the DLS. It will be implemented at the national level and in all provinces to build a culture of data use and

accountability. A key aspect will be analyzing data from the multiple systems to better assess performance of the health system in general.

2. *Establish KPIs that drive action.* Currently, MISAU seldom considers logistics KPIs when assessing the EPI program, although the programmatic success depends on an efficient and functioning supply chain. Clear KPIs for measuring success at both the national and provincial VAN will be established. These KPIs will become an integral part of the monthly logistics data review process and tied to roles that create clear accountability for specific business processes. The KPIs will be added to the information system for real-time measurement of each metric. This work will leverage the VAN Reference Model and the contributions of the Gavi Data for Management working group to create KPIs that are globally relevant, available and appropriate to the needs of Mozambique.
3. *Improved data collection in all provinces.* One of the successes of the DLS is the improved data collection directly from health facilities which is then brought up through the multiple tiers of the system. This same visibility to the service delivery level is desired throughout all provinces but is currently not available due to poor data reporting, particularly when the health facility is not being visited on a monthly basis. Processes will be established to improve data collection, at first starting with low hanging fruit of a few key data points. The VAN will then move into complete data collection redesign, linked to the distribution system design itself. Improved data collection will lead to insight into a few areas MISAU is interested in:
  - Current cold chain inventory with improved visibility into functioning and non-functioning equipment;
  - True wastage rates, the reasons behind them, and recommendations for better stock management to reduce wastage;
  - More reliable data on consumption, by which more accurate coverage rates can be estimated;
  - Transport capacity and management practices;
  - Financial flow issues as related to vaccine distribution; and
  - Disease surveillance.

## Technology

The current DLS logistics teams function as a basic VAN. These teams and their associated processes could be enhanced and fine-tuned to serve the current needs of MISAU and the DPSs to provide end-to-end visibility into the supply chain. However, the current information systems available to MISAU – DVDMT, SMT, and *Modulo Basico* – fall short for ease of usability, functionality and analytics. For an immediate solution, VAN efforts will create manual processes to link the data from these different sources to export to SELV for better analytical capabilities. MISAU and partners will build on the inevitable data gaps from the current systems to move to replacement of these systems. The proposed activities include:

1. *Consolidated platform for data collection and analysis.* SELV will become the first step for a unified vision of all data sources. SELV provides insight into the last mile and analytical functionality that is not available with other data sources. At MISAU's request, SELV will become the automated, consolidated platform to bring the information required at the national level for stakeholder and donor reporting, forecasting, vaccine procurement, transport management, cold chain equipment procurement, and warehouse planning.

2. *Updated web-based dashboard with better tracking of actions to take and accountability measures.* As part of the current continuous improvement model, we regularly receive feedback from the provinces and MISAU on SELV, reporting, and areas that could be enhanced to improve usability and lead to clean, actionable visualization. Reports will be fine-tuned to highlight actionable data, send SMS alerts for immediate action or trends in data that could indicate challenges, and provide better root-cause analysis of poor performing supply chains.
3. *Provide immediate feedback loop to health facilities.* The capability of tablet use of SELV will be enhanced to provide an on-site summary report of KPIs to districts and service delivery points during distribution activities. This work will lead to better analysis of stock information and historical consumption to capture trends over time to improve demand planning. Alerts will be built into the system to highlight trend excursions, such as when consumption has a more than 15% increase or decrease, in order to seek more information to better understand the situation. All Field Coordinators will be equipped with tablets with these real time reports.
4. *Improved GIS and geospatial mapping of transport options to improve efficiencies.* eHealth Africa will apply technologies to map out transport routes and fine-tune GIS codes to improve the transportation systems. Technology solutions will be placed on vehicles to track routes, fuel efficiency, and time spent during distributions in order to find efficiencies. This work will be coordinated with some current, but limited, work being done with MISAU by TransAid.
5. *Systematize new processes for improved data utilization.* Many processes used through the DLS will be expanded to other provinces. Many of these processes can become part of the technology solution for the VAN, such as action-driven reporting with accountability measures linked to performance management processes.
6. *Improve cold chain uptime with remote temperature monitoring.* The initial pilot of real-time monitoring devices has shown success in increasing cold chain uptime through SMS alerts to health workers. Because of these automated alerts when there is a temperature excursion, health workers can immediately react to correct the problem and check for vaccine potency. The same information is also provided to Field Coordinators and the provincial cold chain technician so they can support cold chain monitoring, maintenance and repair more effectively. The real-time monitor device is gathering a wealth of information on temperature excursions and energy system performance which will be included in the VAN through SELV's consolidated platform.
7. *Replacement of less than ideal information systems.* As the VAN is deployed and becomes more routine, the information systems supporting VAN activities will be upgraded to better performing and more user-friendly systems. The DVDMT and SMT will be replaced by a system that can bring more visibility into the performance of the supply chain and drive for continuous improvement. The new system must be capable of meeting Mozambique's global reporting requirements currently performed by DVDMT and SMT.
8. *Adding "What If" functionality.* Recent use of HERMES modelling software by MISAU, DPSs, VillageReach and UNICEF has created substantial interest in using modelling to test various change scenarios. A barrier to any modelling work is collecting and inputting data into the modelling tool. VillageReach has been working with Llamasoft and the HERMES teams to automate the transfer of routine data from OpenLMIS/SELV into those tools. MISAU is requesting this functionality to make modelling a more regular practice which in turn would become part of VAN activities.

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## Policy

With better visibility, key stakeholders and decision makers will be able to identify improvements in supply chain management that also may require changes in current policies. A key responsibility of the VAN, both at the national and provincial levels, is to generate the evidence for any improvements to stock management and make the case for the required policy changes. Some potential policy changes that could come out of improved visibility:

- Updating and revising implementation plans throughout the year to have a more fluid plan that is able to react to immediate needs instead of being locked into an annual plan;
- Optimizing distribution systems/or system redesigning if additional visibility shows inefficiencies or a breakdown of financial flows at certain levels;
- Outsourcing transport if poorly managed transport fleets are an identified bottleneck to an efficient supply chain; and
- Integrating vaccines into the Central Medical Stores supply chain.

## Expected Results

For over a decade, VillageReach has tested and proven the efficacy of the DLS. Its success is seen in its adoption by more provinces and increasing national support for streamlining Mozambique's immunization supply chain and associated improved focus and management. Introducing VAN principles and a VAN takes supply chain management to the next phase of growth in Mozambique by continuing to fine-tune the distribution system and expanding the data visibility, analysis and continuous improvement practices to the national level and non-DLS provinces.

By enhancing data visualization and analytics which then forms the basis for continuous improvement, the following results are expected:

- Improved accountability through action-driven alerts;
- Improved data quality as a result of feedback loops to each level of the supply chain;
- Proactive decision making driven by increased insight into the performance of the supply chain;
- Policy definition informed by data; and
- Improved supply chain performance as a result of improved planning and execution.

## Multi-County Replication

VillageReach's model is to partner with ministries of health and other partners to develop, refine and establish an evidence base for field-tested, proven system innovations that are locally appropriate and globally relevant, then scale and sustain those innovations across multiple countries through the adoption by others. To be successful with this model, VillageReach pursues an "open solutions" approach where we not only document and make our system innovations available free of charge to all others, but actively promote and support their adoption.

The VAN principles and VANs are essential elements needed by Gavi countries as they transition their immunization supply chains from the original EPI distribution model to modern supply chain practices. VillageReach will make its learning, innovations, methodologies and tools developed during the Mozambique VAN work freely available to other countries and actively support counties that want to replicate Mozambique's new approach to immunization supply chain management.

## Appendix A: MISAU Letter of Support for VAN Project



REPÚBLICA DE MOÇAMBIQUE  
 MINISTÉRIO DA SAÚDE  
 DIRECÇÃO NACIONAL DE SAÚDE PÚBLICA  
 PROGRAMA ALARGADO DE VACINAÇÃO

Exmo. Senhor Director da  
 Fundação Bill & Melinda Gates  
 Estados Unidos de América

Nota nº 1048/002 DNSP/2015

Data 29/04/2015

**Assunto: Suporte para o projecto de melhoria no acesso, e visibilidade na utilização de dados de cadeia de abastecimento de vacinas**

O MISAU há mais de 10 anos beneficia-se do apoio da VillageReach através do Programa Alargado de Vacinação (PAV), nas actividades de cadeia de abastecimento de vacinas, implementação do Sistema Dedicado de Logística (SDL), gestão e logística de vacinas e materiais desde o nível provincial até às Unidades Sanitárias. Um dos instrumentos (SDL) utilizados e que traz um impacto directo nas províncias onde a VillageReach opera, mostra um incremento das coberturas vacinais e criação de uma maior eficiência da cadeia de abastecimento de vacinas. No entanto, áreas como o acesso, visibilidade e utilização de dados, continuam a necessitar de mais esforços para a sua melhoria.

Com base numa consulta feita a nível Nacional com participação do PAV e das Direcções Provinciais de Saúde foi desenhado um conceito para melhorar a visibilidade de dados do PAV no país. Esta proposta do projecto da VillageReach visa estabelecer uma visão a médio-longo prazo para os dados da cadeia de abastecimento de vacinas em Moçambique através do desenvolvimento e melhoria do SELV (Sistema Electrónico da Logística de Vacinas), para um sistema integrado que facilitará o melhor acesso e utilização da informação.

Nesta perspectiva, o Ministério de Saúde em Moçambique suporta esta iniciativa nobre que visa o melhoramento da disponibilidade, qualidade e uso de dados para a gestão do PAV e para a tomada de decisões.

Desde já agradecemos a Vossa colaboração e esperamos que a Fundação Bill & Melinda Gates suporte esta iniciativa para a melhoria da qualidade da imunização das crianças e garantia da equidade no estado de saúde em Moçambique.

Atenciosamente,

Director Nacional de Saúde Pública



Dr. Francisco Mbofane

ENDEREÇO:  
 MINISTERIO DA SAÚDE  
 C. POSTAL  
 Av. Eduardo Mondlane/Salvador Allende  
 MAPUTO – MOÇAMBIQUE

MS – DR4 – Formar A4 (21x297 mm) C1.

Telefones: 21326164  
 Telex: 6-239 MISAU MO  
 FAX: 258 (1) 326164

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## Appendix B: MISAU Letter of Support for VAN Project (English translation)



THE REPUBLIC OF MOZAMBIQUE  
MINISTRY OF HEALTH  
NATIONAL DIRECTORATE OF PUBLIC HEALTH  
EXPANDED PROGRAM ON IMMUNIZATION

Honorable Director  
Bill & Melinda Gates Foundation  
United States of America

Note n° 1048 /002 /DNSP/2015

Date 29 /04 / 2015

Subject: Support for the project to improve access and visibility in vaccine supply chain data usage

The Ministry of Health Expanded Program on Immunization (EPI) has been benefiting from VillageReach support for more than 10 years in vaccine supply chain activities, implementation of the Dedicated Logistics System (DLS), management and logistics of vaccines and materials from provincial level to Health Units level. One of the instruments (DLS) used and which brings a direct impact to VillageReach beneficiary provinces, shows an increase in the immunization coverage and fuels greater efficiency of the vaccine supply chain. Areas such as data access, visibility and use, however still require more efforts for their improvement.

Based on an assessment carried out at national level with the participation of the EPI and the Provincial Health Directorates, a concept was developed to improve the EPI data visibility in the country. This VillageReach project proposal aims at establishing a medium-long term vision for the vaccine supply chain data in Mozambique through the development and improvement of SELV (Electronic Vaccine Logistics System), into an integrated system that will facilitate better access and use of information.

In this regard, the Ministry of Health in Mozambique supports this noble initiative aimed at improving the availability, quality and use of data for EPI management and decision-making.

As for now we would like to thank you for your collaboration and hope that the Bill & Melinda Gates Foundation will support this initiative for the improvement of quality immunization of children and health service delivery equality in Mozambique.

Yours faithfully,

National Director of Public Health  
(Signed and stamped)  
Dr. Francisco Mbofana

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ADDRESS:  
MINISTRY OF HEALTH  
P.O.BOX  
Av. Eduardo Mondlane/Salvador Allende  
MAPUTO – MOÇAMBIQUE  
MS – DR 4 – Formato A4 (210x297 mm) C.I.

Telephone: 21326164  
Telex: 6-239 MOH MO  
FAX: 258 (1) 326164