

District Supervision Data System (DSDS) Sustainability Plan

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Read and agreed upon
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2 Introduction

In the initial design of the SURE program the plan was to develop a Pharmaceutical Management Information System (PMIS). Based on discussions with Eddie Mukooyo from the Ministry of Health Resource Center (RC) and Martin Oteba Olowo from Pharmacy Division (PD) however it was decided that the architecture of the PMIS should be based on Data Warehousing and Business Intelligence technology, to

- 1) Avoid development of yet another parallel system
- 2) Build a foundation for the development of the National Health Information Bank as described in the RC strategic plan

SURE program embraced this vision and embarked on the preparations for development of the PIP, the Pharmaceutical Information Portal, as the basis for the National Health Information Bank, to be coined the HIP (Health Information Portal). The PIP was designed to give a comprehensive, transparent, up to date, and quality controlled overview of the supply chain of medicines and health supplies in Uganda from the planning, the funding and financing (through the FACTS –Financial and Commodity Tracking System) down to the delivery of goods to the facilities. By importing the data of sentinel sites with RxSolution also a picture of true consumption (issues to wards) could be given.

One of the data sources planned for inclusion in the PIP is the data collected by the Medicines Management Supervisors (MMS), which is an integral part of the national SPARS strategy. This data was intended to be triangulated with data from other sources, notably HMIS (DHIS2), the medical stores, and mTRAC, to name a few, to provide staff at central and district level with a one-stop shop for evidence based decision making of pharmaceutical management in health facilities.

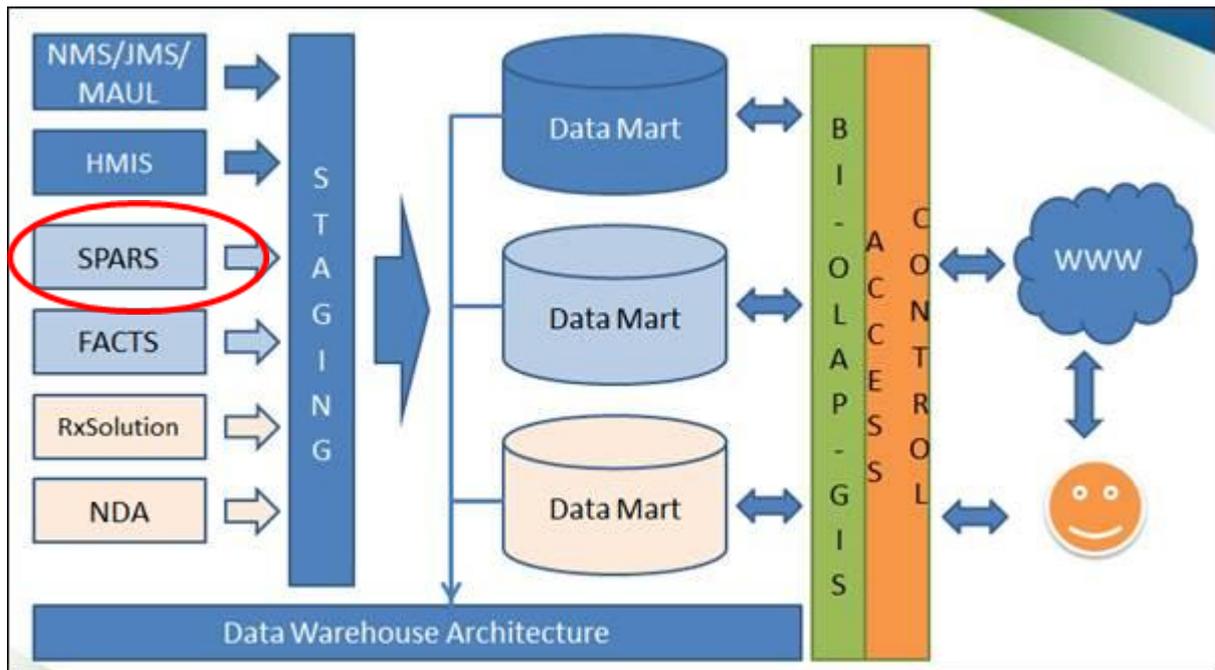
In December 2011 the development of the PIP was halted by a decree issued by the Director General of Health Services to freeze all eHealth developments until further notice. N.B. Up till this date this moratorium has not been lifted, nor directions given to projects.

SURE had to abandon the plan for development of the full PIP but the need to analyze the SPARS data was still pressing. The M&E section used an Excel Spreadsheet to analyze and present the data collected from the supervision forms which was stretching the limits of Excel and the M&E staff. The data collection tool lacked validations at entry. Cleaning and reporting of the data was very tedious and error prone resulting in data of questionable quality. Dynamic analysis was not possible.

To curb with these issues SURE embarked on development of the District Supervision Data System (DSDS). This system consists of two parts:

1. A data entry form used Offline and Online with very stringent quality checks to eliminate the necessity for data quality control after entry – the DSDS SPARS Form.
2. A portal to be used for dynamic reporting and analysis – the DSDS Web Portal.

We used the architecture (Microsoft SQL Server 2008, with DWH/BI extension) and hardware (blade server) of the PIP for the development of the reports and the dynamic analysis of the DSDS Web Portal.



The DSDS SPARS Form has been rolled out into the districts and is used by 190 SURE supported MMS to collect the data of their supervisory visits and by the (currently) more than 130 MMS of the other eleven Implementing Partners supporting the national SPARS roll out. The MMS and other stakeholders can analyze the results using the DSDS Web Portal which provides them an up to date overview of the performance of their facilities. The data is presented using BI technology, with selection boxes and drill downs.

The DSDS provides managers reporting and analysis of the SPARS at the tip of their finger and does not require human intervention for data cleaning and production of reports. As an example: the well-known SPARS National Performance report can be produced taking into account multiple parameters to select the data of interest giving the ability to stakeholders at central and district level to report on SPARS for their area of intervention: Period (Year/Month), Region, District, HSD, Level (HC2/3/4/Hospital/Referral Hospital), Ownership (PNFP/Govt), Implementing Partner supporting SPARS, Medical Bureau supporting SPARS, the responsible MMS for the facility and last but not least: the facility.

Also a dashboard has been provided to give a one stop check on the current performance of SPARS to management. Also here the above mentioned selection criteria can be applied:



Figure 1 DSDS Web Portal SPARS Dashboard

A system of this magnitude and functionality requires considerable effort for the design and development but also for the maintenance of the system, the software, and the hardware. The top side of the coin is the great reduction of staff for data cleaning, following up on MMS, and sending out reports.

The DSDS Server also hosts the data of RxSolution uploads and support, the Good Pharmaceutical Practices tools (NDA) and the Pharmaceutical Financial Management tools, which also require uninterrupted availability of the server. Maintenance and support of these applications is described elsewhere.

3 Implementation of the DSDS

SURE embarked on development of the DSDS SPARS Form and DSDS Web Portal by contracting the software company (Technobrain (U) Ltd) that was selected for development of the PIP by a team consisting of Makerere University, MOH PD, MOH RC, CDC and SURE.

The entire development, the management of the projects and all the costs for the implementation of the DSDS were borne by the SURE program.

The components of the implementation of the DSDS are

- 1 Hardware
- 2 System software
- 3 DSDS software
- 4 Training

3.1 Hardware

Procurement of a dedicated server for the PIP was requested by the Resource Center because the existing hardware was not suitable to run the PIP. A technical workgroup was established with members of Ministry of Health (MOH) Resource Center (RC), Makerere University, CDC and SURE.

In discussions with the RC strengthening taskforce it was found that the use of blade server technology would be preferred to a standalone system, so SURE allocated the following server for the DSDS so it can fit into the proposed midterm infrastructure improvement of the RC:

HP Blade server system, equipped with two servers (quad-core processor, 600GB storage each), 1.8TB shared storage (storage Blade), UPS, 3.2 TB external Backup facility, and interconnection accessories.

A three year warranty was purchased so to make sure the system will be able to host the initial setup and further extensions without the need for hardware upgrades. The cost of the total configuration is \$70,000. For detailed specifications of the hardware see 0

Annex 1 Hardware specifications.

For placing the server into the Resource Centre (RC) Server Room SURE upgraded the power connections for \$1,800.

3.2 System Software

To run the DSDS the following software was selected by the PIP technical workgroup, after evaluating multiple software options for developing a large scale Data Warehouse:

Microsoft SQL Server, Microsoft Data Warehousing and Business Intelligence Suite, Microsoft Sharepoint Server standard edition, 10 CALS, Microsoft Forefront threat management suite.

The cost of the software stack is 17,000\$

Special attention was given to evaluating Open Source Solutions, but the choice was made for the Microsoft stack because of:

- Superior functionality
- Available knowledge in Uganda (training in this software stack is part of the Makerere curriculum)

3.3 DSDS Software

The development of the DSDS has been done by Technobrain (U) Ltd. (230,000\$). Technobrain will provide staff to closely monitor the system for three months after handover. A warranty period of one year after project closure is provided to deal with bugs in the software.

3.3.1 DSDS SPARS Form

The initial version of the SPARS Form was developed using Infopath/Sharepoint technology. Late in the project (during system test by the SURE team) it was found that this configuration could not provide the requested functionality. Technobrain offered to rebuild the solution using the .Net architecture which offers all the functionalities. The synchronization therefore also had to change from Sharepoint Workspace to synchronization between the local databases and the central database.

3.3.2 DSDS Web Portal

The DSDS SPARS Portal is based on the Sharepoint platform with the reports built using Report Builder 3.0, a software tool for which development capacity is widely available. The Online Analytical Processing (OLAP) engine is based on the standard Microsoft Analysis Services.

3.4 Training

3.4.1 Support personnel

The following table shows an overview of the persons trained in the software stack of the DSDS.

Course	RC Sys Adm	PD IT Off	PD M&E	SURE TA PIP	SURE IT Spec	SURE TA Distr Comp	Cost pp (in \$)	Total (in \$)
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HP Blade System Solutions							4,000	4,000
MS SQL Server Implementation							298	595
MS SQL Server maintenance							298	595
MS SQL Server 2008 Integration Services							298	894
MS SQL Server 2008 Analysis Services							298	894
MS SQL Server 2008 Reporting Services							298	894
MS SharePoint Server 2010 Applications							434	1,736
Sharepoint BI							434	2,170
Total Investment								11,778

3.4.2 Users

SURE has trained 190 medicines management supervisors (MMS) and the IP data entrants in data collection using the DSDS SPARS Form and basic analysis and reporting through the DSDS Web

Portal. **Internet**

Internet connectivity at the MOH was due for replacement. The UTL subscription was not functioning well. Based on the MOH technology infrastructure assessment summary report – July 2010, Orange was selected as the preferred supplier and a recommendation was made to connect TB and CPHL to the head office with a fiber connection.

- Orange subscription for 3 years up till 31st of December 2013 was provided and a fiber connection to TB was installed. This incurred a total cost of \$80,000 for installation and a further \$35,000 a year for the Orange subscription

4 Sustain the DSDS

The DSDS SPARS Form and DSDS Web Portal systems are currently running on a server hosted at MSH offices in Bugolobi. SPARS and DSDS Administration is done by SURE staff. Maintenance and first line support of the Blade server is done by SURE IT.

In the long term the server plus all the software will be handed over to the MOH. Handover at this point in time to the ministry is hampered by

- the eHealth Moratorium,
- the lacking management capacity at the Resource Centre,
- and the lacking infrastructure and staff at the Pharmacy Division.

Following is a detailed account of the various components that need to be in place to keep the DSDS up and running, including a cost estimate.

4.1 Server room

Based on the Network Security Audit Report prepared in March 2012 the following needs to be improved in the server room to host national systems:

- Provide a biometric lock to access the server room.
- Install fire protection devices
- Install a CCTV unit inside the server room
- Ensure proper cooling by adding more (automated) air conditioners
- Blocking the windows of the server room
- Provide proper anti-virus protection
- Implement a new firewall

These costs are not directly related to the operation of the DSDS/PIP/HIP but these investment need to be made to ensure data security of all the systems in the data center.

The server needs to be connected to an uninterrupted power source. With an automatic start generator a battery time of 1 hour UPS should suffice. MSH has provided a 16KVA generator exclusively for the server room fitted with an automatic changeover switch.

4.2 Support Server

The following is a rough estimate of the yearly costs to maintain the DSDS server.

Item	Yearly cost in \$
Maintenance of server parts (cabling, hard disks)	1,000
Maintenance and replacement batteries	300
Tapes	600
Replacement network devices	1,000
Cleaning three times a year	300
Total	3,200

4.3 System Software

There is no yearly license fee for the software acquired. Estimated is that software needs to be upgraded to a new release every three years. The upgrade is estimated to cost 10,000\$, annual costs \$3,500.

4.4 DSDS Software

The vendor has a maintenance obligation for correcting defects in the software for one year after commissioning.

The architecture of the DSDS is designed to facilitate dynamic analysis by end-users which eliminate the need for an on-site development team to frequently update reports based on user requests. One of the requirements of the DSDS development is an architecture that makes it possible for a systems developer, who has been trained in the Microsoft BI stack, to apply simple changes. If complex changes in reports need to be applied that cannot be handled by RC staff the vendor can provide a system developer at an hourly cost of approximately 45\$.

Planned major extension of the data sources and subsequent reporting and analysis can be achieved by a trained system developer or it can be outsourced to the software company which developed the DSDS or any other selected software development company. Because the architecture of the DSDS is ready for extension the development efforts will be much less than for the initial built up of the data warehouse/business intelligence system, but the cost depends on the size, number and complexity of the data sources and analysis.

4.5 Internet

To run a successful Web based system the access to the system has to be uninterrupted. For sustaining a high speed internet connection a yearly fee of 35,000\$ is required.

4.6 Support Staff

To successfully support the MMS, keep the DSDS SPARS up to date, operate the DSDS and ensure its constant availability and high performance the following roles need to be in place:

4.6.1 DSDS SPARS Support

This team supports the MMS in the following aspects.

- Installation of the off line software.
The support team carries the latest version of the off line software on a memory stick and helps with installation, and solving minor problems.
- Supervision of MMS in entering, validating and submitting forms.
The support team has thorough knowledge of the SPARS form indicators, the guidelines for collecting data and the automated checks.
- Coordinating changes in the master lists and functionality of the form and software
Errors found or suggestions for improvement by the MMS are discussed with the regional team, the peer colleagues and their PD supervisor. One resolution is made and presented to the DSDS SPARS admin. Changes in the master lists have to be quality controlled and

brought to the attention of the DSDS SPARS Administrator through the same path.



Currently the DSDS SPARS Support Role is performed by the SURE Pharmaceutical Field Coordinators and PD staff. After SURE ends the Regional Pharmacists will (within the Peer Strategy) take up this role. They are in turn supported by members of the Pharmacy Division. In 0

Annex 2 Overview of Peer Support an overview of regional pharmacists, their districts and their supporting PD member is shown.

In the DSDS Portal the Peers can obtain information about the performance of the facilities and the efficiency/effectiveness of the MMS in the reports section. Also a predefined monthly report is produced which highlights areas for support. For the support of the Peers in supporting the MMS manual has been prepared which is accessible from the DSDS Portal.

4.6.2 DSDS SPARS Admin

The DSDS SPARS Admin is in charge of the well-functioning of the DSDS SPARS Form offline and online application. The maintenance of the DSDS Master lists and granting user access rights are the core activities. The DSDS SPARS Admin also coordinates the collection and analysis of the change requests being brought to his/her attention through the PD DSDS SPARS support member.

- Maintenance of the master lists
The DSDS uses four master lists: Facilities, Sub districts, MMS, and Professions.
- Granting access to users
- Evaluating and follow up of change requests

The DSDS SPARS Admin role is now being handled by the TA PIP of the SURE program. A manual has been prepared to aid the DSDS SPARS Admin in his duties.

4.6.3 DSDS DWH Admin

Data from the forms will be loaded into the DSDS Data Warehouse through an automated procedure scheduled to run daily. This procedure reads the data from the current master lists (from Sharepoint) and the submitted forms (from the SPARSFORM database) and through an elaborate process (ETL – Extract – Transform - Load) loads the data into the Data Warehouse. The DSDS DWH Administrator is responsible for the successful completion of this job. Currently this task is handled by the TA PIP.

4.6.4 DSDS Systems Admin

The DSDS System is hosted on blade servers using virtualization which have unique configuration and maintenance requirements.

Currently this role is being performed by the SURE Senior IT Specialist, but only limited to the regular maintenance and basic trouble shooting. To be able to make changes to the system (adding virtual machines, changes in configuration) additional training needs to be provided.

The configuration of the server and the software, the regular maintenance task and basic trouble shooting hint and tips are provided in a manual.

4.6.5 DSDS Database Admin

The role of the DSDS Database Admin is now performed by the TA PIP and will be handed over to the DSDS Systems Admin. Database administration will be limited to making sure the backup and recovery procedures are being executed as specified. In a follow on program this role will be taken

out of the Systems Admin responsibilities and will again include design and performance tuning of Databases.

4.6.6 Software developer/BI specialist

The Supplier of the DSDS Software has a warranty obligation of one year after sign off for the developed DSDS SPARS form and the DSDS Portal software. Issues reported will be collected and analyzed by the DSDS SPARS Administrator and passed on to the responsible cadre at Technobrain (U) Ltd. The DSDS SPARS Administrator will also follow up on the successful completion of the fix. In the DSDS SPARS Admin manual a section is provided for guiding the process when errors in the software are recognized and how to deal with the upgrades of the (mainly offline) software.

4.7 Access

The functional system is owned by the Pharmacy Division of the MOH and the decision and responsibility for granting access to the data has to be within PD. The task is performed by the DSDS SPARS Admin who gets directions from the Peer Support partner within the PD.

5 Hosting options

For hosting the DSDS environment we evaluated the following options:

#	Host	Server room	Support	Internet	Politically feasible	Total points	Installation Costs in US\$	Remarks
1	MOH PD	0	0	0	100	100	275,000	Server room, training
2	CPHL	100	0	100	0	200	5,600	Transport, training
3	Pharm Dept Makerere	0	0	0	0	0	275,000	Server room, training
4	USAID IP (MEEPP)	0	50	100	0	150	20,600	Transport, training
6	USAID IP (TrackTB)	100	50	100	100	350	600	Training
7	Cloud Hosting	100	100	100	0	300	130,000	Contract

Below are the details that show how the points were given.

5.1 MOH PD

The Pharmacy division – being a politically and functionally logical place for DSDS support – at this point in time cannot host the server without considerable investments. The space in the Annex building is hardly sufficient to host the staff, let go of a server in its own room, there is no technical IT staff available, and the internet connection with the main building is instable.

Please note that the SPARS and DSDS User support will be based at the PD as soon as possible

5.2 CPHL

CPHL has a very well designed server room and a stable internet connection (which however depends on funding). There is no system administrator on site who can be trained to maintain the server. CPHL hosts the DHIS 2 servers after the server room at the MOH became unusable after a fire. It would be a feasible host for the DSDS server once the MOH has lifted the moratorium and accepted the DSDS.

5.3 Makerere University – Pharmacy department

The Pharmacy department of the Makerere University can only host the server with considerable investments – much equal to the PD. Although lecturers of the department are involved in training MMS the support of the MMS is not in their hands.

5.4 USAID IP – (e.g. MEEPP)

MEEPP has a strong IT team and supports a clone of the DHIS2 – the Hybrid system. There is no hardware support since the Hybrid is located in the cloud and not on a server supported by the local MEEPP system administrator. There is no affinity with the SPARS intervention so not a logical place to host the DSDS.

5.5 SPARS/USAID IP – (Track TB)

Also partners in the roll out of (TB) SPARS, so a potential stakeholder in the use of DSDS. The server is already hosted in the MSH premises where a good server room has been designed. Attention needs to be given to the IT support of the server in the interim period between SURE and the follow on program.

5.6 Cloud Hosting

Albeit the thought of ultimate solution in resource limited settings because of availability of support and power, in this case not sustainable because of the high recurring costs. If these cannot be borne the system will become unavailable.

6 Recommendation

SURE proposes to keep the server under the guard of SURE till the end of the program and hand over to the follow up of the SURE program so support and further development of the DSDS can be continued. If a follow up is not identified before the end of the SURE program the server will be hosted at MSH Premises supported by the IT team under COMU under the responsibility of Track TB.

7 Annex 1 Hardware specifications

The specifications of the Blade server are below including the usage of the processor capacity and disc space:

Rack Enclosure Details

- 16 (c7000) form factor (10 free slots)
- 12TB Storage Blade (free) – Redundant
- 3TB Storage Blade (Raided to 1.9 TB) - main

Blade server (each)

- HP ProLiant BL620c G7
- 2 x Intel® Xeon® E6540 (12 core, 2.00 GHz, 18MB L3, 80W)
- 100 GB RAM
- 2 x 10GbE NC553i FlexFabric 2 Ports
- 1 Integrated SATA
- 600 GB Hard disk Storage Internal

Server Cluster Usage

- DSDS: 27% Memory usage of main server, 257 GB storage space including TMG
- GPP: 11% memory usage of Main server, 100 GB storage space
- Overall Storage Cluster: 1TB used, 0.9TB free
- Overall memory usage:
 - Main: 56 GB used, 44 GB free
 - Redundant: 8 GB used, 92 GB free

