USAID | DELIVER PROJECT

TURNING THE DIGITAL CORNER:

ESSENTIAL QUESTIONS FOR PLANNING FOR A COMPUTERIZED LOGISTICS MANAGEMENT INFORMATION SYSTEM

FEBRUARY 2009

This publication was produced for review by the U.S. Agency for International Development.
It was prepared by the USAID | DELIVER PROJECT, Task Order 1.

TURNING THE DIGITAL CORNER: ESSENTIAL QUESTIONS FOR PLANNING FOR A COMPUTERIZED LOGISTICS MANAGEMENT INFORMATION SYSTEM

The authors' views expressed in this publication do not necessarily reflect the views of the U.S. Agency for International Development or the United States Government.

USAID | DELIVER PROJECT, Task Order 1
The USAID | DELIVER PROJECT, Task Order 1, is funded by the U.S. Agency for International Development under contract no. GPO-I-01-06-00007-00, beginning September 29, 2006. HIV-related activities of Task Order 1 are supported by the President's Emergency Plan for AIDS Relief. Task Order 1 is implemented by John Snow, Inc., in collaboration with PATH, Crown Agents Consultancy, Inc., Abt Associates, Fuel Logistics Group (Pty) Ltd., UPS Supply Chain Solutions, The Manoff Group, and 3i Infotech. The project improves essential health commodity supply chains by strengthening logistics management information systems, streamlining distribution systems, identifying financial resources for procurement and supply chain operations, and enhancing forecasting and procurement planning. The project also encourages policymakers and donors to support logistics as a critical factor in the overall success of their health care mandates.

Recommended Citation
USAID | DELIVER PROJECT, Task Order 1. 2009. *Turning the Digital Corner: Essential Questions for Planning for a Computerized Logistics Management Information Systems.* Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1.

Abstract
As countries continue to expand health programs and strengthen the supply chains that support them, there is an increased need for user-friendly tools and software packages to support the management of logistics information to organize and analyze timely, accurate data that can be used for decision making, as well as for advocacy and resource mobilization. This guide is geared towards countries and programs that are interested in computerizing their logistics management information system (LMIS). It should be used as the first step in the computerization process, and is part of the broader software development process.

Cover photo: Staff members in Bangladesh using a web-based LMIS. 2008.

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ACRONYMS

AIDS	acquired immunodeficiency syndrome
C-LMIS	computerized logistics management information systems
HIV	human immunodeficiency virus
LMIS	logistics management information systems
MOH	Ministry of Health
IT	information technology
SDP	service delivery point
SOP	standard operating procedures
USAID	U.S. Agency for International Development

ACKNOWLEDGMENTS

This publication is dedicated to the many individuals from communities, nongovernmental organizations (NGOs), faith-based organizations, Ministries of Health, and other organizations that have consistently fought for access to health commodities for a variety of health services. The publication is also dedicated to friends and counterparts who have worked with the USAID | DELIVER PROJECT, the Family Planning Logistics Management project, and John Snow, Inc., since 1986 and to the thousands of committed professionals in Ministries of Health and NGOs who work daily to supply their customers and programs with essential public health commodities.

U.S. Agency for International Development (USAID) contracts funded the technical assistance, in-country projects, and research that produced the experience and lessons contained in the resources. We are deeply grateful to the team of professionals in the Commodity Security and Logistics Division in the Office of Population and Reproductive Health of the USAID Global Health Bureau's Center for Population, Health, and Nutrition for their encouragement and advice and their commitment to improving public health programs through logistics.

Sincere thanks go to the core team of dedicated technical staff who developed and wrote this document both in the field offices and in Washington, DC. The lessons drawn from the USAID | DELIVER PROJECT's experience in managing supply chains would not have been possible without these valuable contributions.

EXECUTIVE SUMMARY

As countries continue to expand health programs and strengthen the supply chains that support them, there is an increased need for user-friendly tools and software packages to support the logistics information management to organize and analyze timely, accurate data that can be used for decision making, as well as for advocacy and resource mobilization. This guide provides countries and programs that are interested in computerizing their logistics management information system (LMIS) with a process and structure for developing their vision for a computerized LMIS (C-LMIS), and for determining what resources are needed to implement that vision. This is the first step in the software development process, and should precede an exercise gathering user requirements.

There are three basic parts to this guide:

1. Assessment of current logistics system, resources, and context
2. Development of a vision for a C-LMIS.
3. Analysis of the vision as compared to the current system, resources, and context

After utilizing this guide, the core team should draft and present the vision for the C-LMIS to the key stakeholders identified so that outstanding issues can be discussed and consensus can be reached, before moving onto the next step of the software development process, gathering the user requirements.

INTRODUCTION

As countries continue to expand health programs and strengthen the supply chains that support them, there is an increased need for user-friendly tools and software packages to support the logistics information management to organize and analyze timely, accurate data that can be used for decision making, as well as for advocacy and resource mobilization. The process of undertaking computerization – whether it is selecting and customizing existing solutions or developing new software – can be a daunting task, especially if there is limited understanding of where the process begins and the different steps in that process. While computerization can greatly facilitate the work of supply chain managers, the implementation of software packages can be costly and time consuming, requiring planning and management to achieve optimal outcomes. Adequate time and human, financial, and information technology (IT) resources must be allocated during every step of the software development process to ensure that the most appropriate software package is chosen and maintained.

PURPOSE OF THE GUIDE

This guide provides countries and programs that are interested in computerizing their logistics management information system (LMIS) with a process and structure for developing their vision for a computerized LMIS (C-LMIS), and for determining what resources are needed to implement that vision. It should be used as the first step in the computerization process, and is an integral part of the broader software development process. Throughout this guide, references will be made to existing tools and resources for other steps in the software development process, including user requirements gathering, and the actual selection of the software.

There are three basic parts to this guide:

1. Assessment of current logistics system, resources, and context

Included in this process are the identification of stakeholders to be involved, outlining the scope of the tool, and assessing the current and potential resources available to support the development of a C-LMIS.

2. Development of a vision for a C-LMIS.

This consists of identifying what the system will be able to do, what logistics functions it will support, and defining the objectives and desired results of computerization.

3. Analysis of the vision as compared to the current system, resources, and context

The objective of this section is to determine whether the available resources are able to support the development, implementation, and maintenance of the C-LMIS.

An LMIS does not operate in a vacuum, but in a dynamic environment, where other computerized systems are already being invested in, planned for, and implemented. In recognition of these linkages, the computerization or automation of the entire supply chain will involve more than just the LMIS. IT can be used to improve management for a wide range of logistics activities, and this guide does not attempt to help users to identify and prioritize which aspects of their logistics operation would most benefit from an IT application. Users of this guide should think about investing in LMIS as one part of larger supply chain computerization efforts, examples of which are a vendor management system, a warehouse information system, or a transportation management system.

Investing in any computerization efforts is a fundamental change to a logistics system, as IT and logistics are tightly coupled. Computerizing bad management practices can only waste money and make poor processes operate faster while achieving no performance improvement. Although the focus of this guide is on LMIS, the assessment and visioning process is useful for virtually all IT initiatives.

WHO SHOULD USE THIS GUIDE

Software development involves input from a variety of people, including sponsors, end users (which could include data entry clerks, service providers who record and report the data and MOH program managers among others), developers, testers, and project managers. A project manager plays a critical role interpreting between the end users and the software programmers. This guide should be completed by a multidisciplinary core team of individuals comprised at a minimum of a logistics manager, project manager, and IT staff with the goal of presenting the results to key decision makers and stakeholders. Where possible, include the future users or beneficiaries of the C-LMIS users as part of the team. As no single person will be able to grasp and explain what is demanded from every level and dimension of the supply chain, a group of people are required to be involved in the completion of this assessment and visioning process. A shared vision that compliments the program's capabilities will follow only when consensus has been built.

HOW TO USE THE GUIDE

Investing in IT is not a trivial decision. The purpose of IT is to make data accessible and usable for timely decision making, and the costs of an IT investment should be justified by desired improvements in service or effectiveness–or by improved efficiency. This guide should be used as the first steps in planning for a C-LMIS, prior to gathering user requirements, and could be combined with a requirements gathering activity. Building a vision for a C-LMIS and assessing current and future resources must take place before gathering user requirements. There are two ways that the questions posed in this guide could be completed:

- as a 1-2 day-long meeting with key stakeholders, or
- by a core team meeting individually with relevant stakeholders if a 1-2 day-long meeting is not possible

Depending on the format chosen, the initial assessment and analysis as guided by this tool, could be completed in two to five days. After completing the questions in Parts I and II of the guide, the core team should analyze whether the available resources (now or identified as available in the future) fit the vision that is outlined.

Critical Pre-Requisite: In order to use this guide, a logistics system needs to have been designed and procedures for operating the system clearly documented. The system design should include an inventory control system, a distribution plan, and the records and reports for an LMIS, including feedback reports. Efforts towards computerization should only happen after a system has been designed. See the USAID | DELIVER PROJECT publication *Designing Logistics Systems for Health Commodities* for more information on system design.

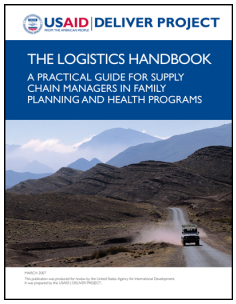
LOGISTICS MANAGEMENT INFORMATION SYSTEMS AND OTHER MANAGEMENT INFORMATION SYSTEMS

It is important to clarify the difference between LMIS and other management information systems such as Warehouse Management Systems (WMS), Transportation Management Systems, billing and accounting systems or any of the myriad other types of systems that support a logistics operation. The difference between a logistics management information system (LMIS) are the other kinds of systems are the decisions that the system helps to inform. A warehouse management system (WMS), for example, helps to manage and control products within a warehouse and manage warehouse processes, such as receiving and put away, order processing picking and packing, and shipping products out of the warehouse.

An LMIS is the system of records and reports used to collect, organize, and present logistics data gathered across all tiers in a system that can be used to make supply chain decisions like establishing inventory levels, scheduling procurement and setting and measuring system performance targets. In a public health setting, the collection of data for logistics operations has been, at times, confounded with the collection of data for other purposes, particularly with health information systems (HIS) that track incidence of disease and health service delivery. Logistics information and health information management are designed to facilitate very different decisions, often by different stakeholders. The types of questions that can be answered using logistics data are:

- What is the demand for a product through this system over a certain period of time?
- How long will current supplies last? When do we need to procure supplies?
- Where are our supplies in the pipeline? Do we need to move supplies between tiers in our system?
- Where is demand the highest? What are the implications for positioning inventory?
- Are we experiencing losses from the system that require us to take action? Where are losses occurring and what are the causes of those losses?
- Are supplies flowing smoothly through the pipeline? Do we need to adjust our inventory to account for bottlenecks in the system?

Hundreds of decisions can be made using the appropriate data. To make logistics decisions, a logistics manager needs three essential data items: (a) *stock on hand,* (b) *rate of consumption,* and (c) *losses and adjustments*. Although we may make good use of other data items in logistics, these three data items are *absolutely required* to run a logistics system. For more information about logistics data or LMIS, refer to the USAID | DELIVER PROJECT's *The Logistics Handbook*.



SOFTWARE DEVELOPMENT PROCESS

The creation of a computerized system – any computerized system – is a process and not an event. This guide should be considered the initial step in the software development process and should be a key part of the "Project Planning" step depicted in the software development cycle in Figure 1 below. For more guidance and information on subsequent steps in the software development process, see the USAID | DELIVER PROJECT's *Guidelines for Implementing Computerized Logistics Management Information Systems, Second Edition.*

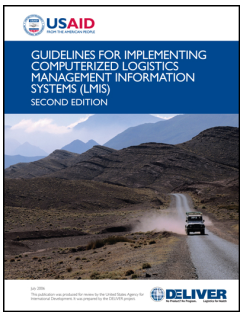
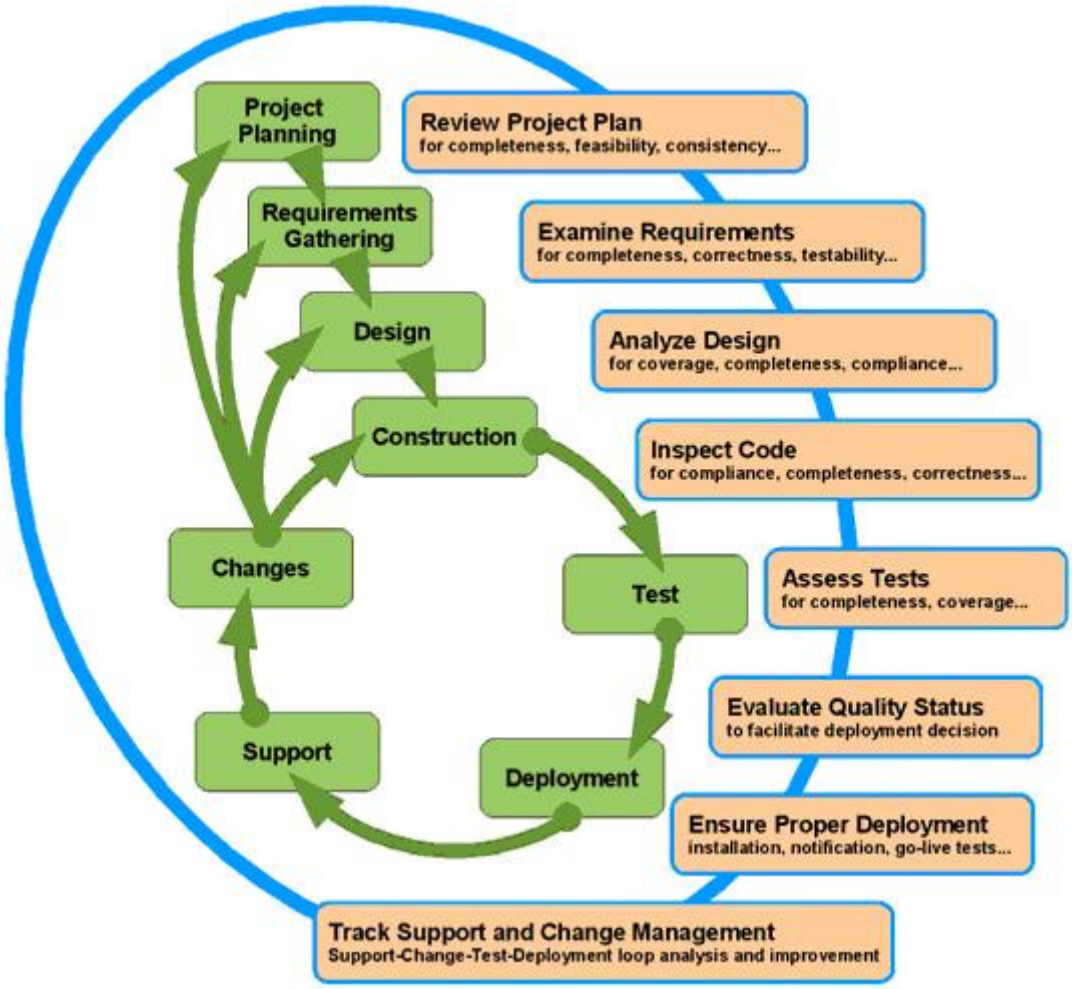


Figure 1. Software Development Cycle (source: http://edocs-itsolutions.com/)



ASSESS CURRENT SYSTEM, RESOURCES, AND CONTEXT

The first step in planning for a C-LMIS is to assess the current logistics system parameters, resources, and stakeholder involvement. Completing this step ensures that all those involved with the C-LMIS development agree on the foundation from which the C-LMIS will be built, and have thought through the environment in which the C-LMIS will operate. There are 4 basic parts to assessing the current situation: logistics functions and operating parameters; leadership and stakeholder involvement; other existing computerized systems; and human, financial and IT resources.

LOGISTICS FUNCTIONS AND OPERATING PARAMETERS

As mentioned in the introduction, prior to embarking on a C-LMIS development process, a logistics system needs to have been designed. The purpose of this section is to describe in detail the parameters of the logistics system. In addition to answering the questions below, the core team should diagram the pipeline and the current flows of information and products.

Table 1. Logistics Functions and Operating Parameters: Questions and Responses

	Question	Responses
1.	What commodities are being considered for inclusion?	☐ Contraceptives ☐ ARV drugs ☐ HIV test kits ☐ Laboratory commodities ☐ Malaria drugs ☐ TB drugs ☐ Essential medicines ☐ _____ ☐ _____
	Are these commodities managed through the same logistics system? (If there are separate logistics systems, the questions should be answered for each logistics system)	

2.	How many facilities are there in the logistics system?	
3.	How many levels are there in the logistics system?	☐ Two (central and SDP) ☐ Three (central, provincial/regional, and SDP) ☐ Four (central, provincial/regional/district) ☐ Other: _____
4.	At which level(s) are resupply quantities calculated?	☐ SDP level ☐ Intermediary level (please specify: _____) ☐ Central level
5.	How stable is your current logistics system? When was it designed and implemented?	
6.	Do facilities operate on a budget-based ordering system? (Does facility financial/budget information need to be included in the C-LMIS?)	☐ Yes ☐ No

7.	Are you currently using an automated tool or system to help aggregate and analyze logistics data? If so, what is the current system not helping you to do?	
8.	Draw a diagram of the flow of information between and within levels of the system. Should include the names of the forms and/or data.	

LEADERSHIP AND STAKEHOLDER INVOLVEMENT

Committed and skilled staff designing, managing, programming and using the C-LMIS will help contribute to a successful system. In addition to the staff actually using the system, other stakeholders should be involved in the computerization process, beginning with the visioning. Everyone who comes into contact with a C-LMIS will have expectations about how the system

should work, what information it should provide, how the information should be provided, and when the system will be completed. The purpose of this section is to identify the stakeholders who will play some role in the development and use of the C-LMIS as a first step towards building this consultative approach.

Table 2. Leadership and Stakeholder Involvement: Questions and Responses

	Question	Response
1.	What stakeholders use logistics data at the central level? For each stakeholder, briefly describe their role in the supply chain and their data requirements.	☐ Central Medical Stores Role: ☐ Ministry of Health (List all departments) Role: ☐ Donors (list all donors) Role: ☐ Other: _____ Role:
2.	Do health workers at the service delivery level or staff at any intermediate tiers receive feedback reports on the logistics system in general and/or their performance with	☐ Yes ☐ No

	regards to logistics activities?	
3.	Do key decision makers receive and manage logistics information for decision making? If so, who are these key decision makers? What are the most critical decisions that require a high level of data management support?	☐ Yes ☐ No

RELATIONSHIP WITH OTHER COMPUTERIZED SYSTEMS

There are likely other computerized or automated systems within the country or program that have been developed or in the process of being developed. These systems could have some logistics functionality, and it is critical not to duplicate efforts. For example, some computerized systems function as Health Management Information Systems (HMIS) but may contain some logistics information. There may also be some facility based systems in place or being developed, which may need to link or share information with the LMIS. A smart card or cell phone system may be used at certain levels to collect or transmit data. In the following table, list each stakeholder, organization, or unit which has a computerized or automated system which may affect or influence the C-LMIS. A stakeholder could be the Ministry of Health, the Central Medical Stores, donors, NGOs, or

others. In addition to answering the questions below, the core team should diagram how the different systems interact with each other, if in fact they do.

Table 3. Relationships with other computerized systems

Stakeholder/ Organization/ Unit	Computerized system or automated tool	Purpose of System/Tool	Level of the logistics system system/tool is utilized

HUMAN, FINANCIAL AND INFORMATION TECHNOLOGY RESOURCES

Developing a computerized LMIS requires significant resources; this influx of resources cannot be a singular event. As computerization is a process, continued and sustained resources will be required to facilitate success. These resources are in three primary areas: human, financial, and information technology. The purpose of this section is to describe the context in which the C-LMIS will operate, and will eventually help in the implementation of the system.

Table 4. IT Resources: Questions and Responses

	Question	Response
1.	Where would the C-LMIS likely be hosted?	☐ Central medical stores/warehouse ☐ Ministry of Health (specify department: _____) ☐ 3rd party IT provider (specify if known: _____) ☐ Other: _____
2.	What human resources are currently available to be involved with logistics information management, including logistics personnel, data entry, and IT support staff? What staff could be made available?	☐ Data entry: _____ ☐ IT support staff: _____ ☐ Logistics personnel: _____ ☐ Other (specify): _____ ☐ Other (specify): _____
3.	Who is going to enter the data into the system?	

4.	How many users might need to access the system/enter data at the same time? Where do they sit?	
5.	How will users access the software for data entry and for preparing and downloading reports?	
6.	What is the current IT environment in the program, given where the system will likely sit and who the users of the system are?	Is there available: ☐ Computers/hardware ☐ Server/Network ☐ Internet connectivity Comments:
7.	What are current financial resources dedicated to logistics management information? Are there any potential sources of future funding?	

DEVELOP THE VISION

Key to the success of a C-LMIS is the development of a vision for the system, and determining if resources can be made available to achieve that vision. Since programs and contexts can change, developing a clear vision for the C-LMIS is critical for the development process, including choosing the appropriate software. Answering the questions below will help develop a vision, which is as important as the ultimate outcome.

Benefits of developing a vision include:

- determining and clarifying expectations of policymakers and users of the system on what the system will eventually be able to do as well as how long it might take to implement
- reaching consensus on what functions the system will support
- cultivating buy-in from all relevant stakeholders
- building ownership of the system
- defining the objectives and desired results of computerization
- identifying the resources that need to be mobilized for the development and ongoing maintenance of the system

LOGISTICS FUNCTIONS AND OPERATING PARAMETERS

The purpose of this section is to build consensus around what functions the C-LMIS will support, the stability of the current logistics system, and the objectives and motivations for computerizing.

Table 5. Logistics Functions and Operating Parameters: Questions and Responses

	Question	Response
1.	Why do you want to computerize? What will you be able to do better with a computerized system?	

2.	What actions/decision will be facilitated by a computerized system?	☐ Calculate resupply quantities for the facilities ☐ Monitor the quality, completeness, and timeliness of reports from facilities ☐ Assess national stock status ☐ Aggregate consumption and stock on hand data ☐ Calculate losses experienced in the system ☐ Determine quantities to redistribute between facilities ☐ Adjust reported data to account for non-reporting facilities ☐ Track discrepancies between: i. Quantity ordered and quantity approved ii. Quantity ordered and quantity supplied iii. Quantity supplied and quantity received ☐ Other: _____ ☐ Other: _____ ☐ Other: _____
3.	At which levels of the logistics system will computerization occur? What level is the first priority?	☐ Central level ☐ Intermediary level (please specify: _____) ☐ SDP level
4.	How will you measure the performance of your logistics systems?	☐ Loss rates ☐ On-time reporting rates ☐ Number of facilities appropriately stocked, and/or stocked out ☐ Order fill rates ☐ On-time order processing rate ☐ Number of products stocked out

		☐ Other: _____ ☐ Other: _____ ☐ Other: _____
5.	Do you require any changes to the functions or parameters to the system, or any other management or organizational changes in the next 5 years? Is a system re-design or revision anticipated?	
6.	Are any other products or distribution systems likely to be integrated into the C-LMIS for the next 5 years? If so, list them in priority order. Do these have any special data management requirements?	
7.	What functions will the C-LMIS support? What other systems will the data aggregated by the C-LMIS feed into?	☐ Warehouse management ☐ Financial management ☐ Order processing ☐ Forecasting and Quantification ☐ Transportation ☐ Other: _____

8.	Draw a diagram of the proposed flow of information between and among levels of the system.	

LEADERSHIP AND STAKEHOLDER INVOLVEMENT

Many stakeholders are likely to be involved with some aspect of the C-LMIS development and the management of logistics data. The purpose of this section is to outline the roles and responsibilities of each stakeholder, including identifying who will be the leader or champion of the process is critical to ensure that the computerization process will run smoothly.

Table 6. Leadership and Stakeholder Involvement: Questions and Responses

	Question	Response
1.	What stakeholders need to be consulted or kept informed in this process?	
2.	Who will be responsible for the successful implementation of the C-LMIS?	

3.	Who could and would champion or sponsor the C-LMIS from host organizations or partner institutions?	
4.	What organizations could host and support the C-LMIS? What are their strengths and weaknesses?	
5.	Are logistics decision-makers expected to access the application directly or will an intermediary gather the reports, print them out and deliver the reports to them (or email the reports)?	
6.	Who will determine if the computerization project can proceed and what information do they need to make a decision?	

ANALYZE THE RESPONSES AND FINALIZE VISION

One major role of the visioning exercise is to determine and clarify expectations of policy makers and users of the system by identifying the financial, technical, and human resources available and ensuring that these are adequate to develop or customize a C-LMIS that meets the country requirements. After responding to the questions in the above sections, the next step is to utilize those answers to compare the current and future resources available with the vision of the C-LMIS.

Using the answers in the previous two sections, the core team implementing this guide should:

1. Summarize the existing logistics system, current resources, current other computerized systems and stakeholders, including diagrams and maps of the flow of commodities and flow of information.
2. Summarize the vision, including a map of how the computerized system will interact with other computerized systems, if at all, and key stakeholders
3. Conduct an analysis, comparing the vision to the current situation, and identify any outstanding issues that should be resolved before and during designing and building the C-LMIS.

This document should be circulated to the key stakeholders identified so that outstanding issues can be discussed and consensus can be reached, before moving onto the next step of the software development process, gathering the user requirements.

Some key features of conducting this analysis include:

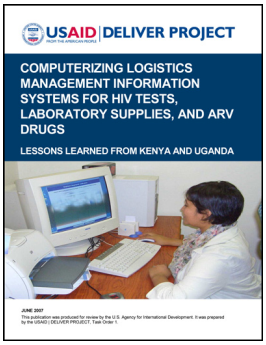
- Considering where the system will be housed:
    - Are the human resources enough?
    - Is the IT environment adequate (i.e. are there computers, a server, internet connectivity, etc.?)
    - Does the vision include having the system web-accessible, and if so, have the data access and security issues been identified and addressed?
- Considering logistics functions:
    - What processes will the C-LMIS support?
    - If changes are to be made to the system, what should be completed before designing and building a C-LMIS?
    - What are the major logistics functions that will be done by the C-LMIS?
    - What logistics functions will data from the C-LMIS feed into?

    - Do any existing computerized systems have an LMIS component and how will that be addressed with the introduction of a new C-LMIS?

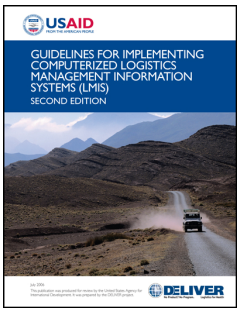
- Considering stakeholders:
    - Considering who will be the champion of the C-LMIS process, are the human resources enough? Is there sufficient funding?
    - Do any roles and responsibilities for stakeholders need to be further clarified or discussed?

The core team completing this guide will have to determine if the vision needs to be adapted or revised, given the existing and potential resources available. Once the analysis is finalized, it is likely that the core team will have to present the finalized vision or one or more options for finalizing the vision to the larger group of stakeholders and decision makers. Presenting the final vision or options and obtaining stakeholder input and validation for the final decisions is critical for managing expectations and building local ownership, which in turn are critical to the success of developing a C-LMIS. To do this, stakeholders must be involved in the initial planning and visioning, and agreement should be reached on roles and responsibilities. It is important to reach consensus on the expectations of what the C-LMIS will do, where it will sit, who it will be championed by, and how it will support logistics functions. The human, financial, and technological resources required will help to form those expectations.

To finalize the vision, refer to the USAID | DELIVER PROJECT's *Computerizing Logistics Management Information Systems for HIV tests, Laboratory Supplies, and ARV Drugs* for concrete country experience in C-LMIS development.



NEXT STEPS



For a detailed description of each of the steps in the software development cycle, refer to the *Guidelines for Implementing Computerized Logistics Management Information Systems (LMIS), Second Edition*. The timelines given below are for illustrative purposes only. The time it takes to complete each step is dependent upon many factors, and can be country- and situation-specific.

REQUIREMENTS GATHERING

After completing the visioning process, the next step is to gather the user requirements for the system. Having clear and well explained requirements will serve as a primary reference for the rest of the software development process. Two valuable components of the requirements gathering process are the system functions and the illustrative outputs. The system functions, or use cases, depict the interaction between the users and the computerized system to accomplish a particular objective. Use cases represent the basic functions of the C-LMIS, such as receiving or issuing products. The illustrative outputs are sample reports using real data where available. These sample reports are useful in letting users see what they will get out of the system. The requirements gathering step should take approximately two to three weeks for a central level LMIS.

DESIGNING

After the requirements have been gathered and agreed upon, the next step is to design the system. This design includes descriptions for how the new system will look and act. At the end of this step the output will be a System Requirements Specification (SRS) document. This step should take approximately two to three weeks, and does not necessarily need to be in-country.

BUILDING

The SRS document, outlining the specifications for the system, is utilized to actually build and develop the LMIS. The development process includes the following steps: applying naming conventions to software objects, applying coding standards to software code, and controlling the software code. The building and testing phase depends on too many factors to give a specific time range, but can take anywhere between 4 weeks to eight months.

TESTING

Testing software before it is put to use is a critical activity in developing and implementing a computerized LMIS. Managers should plan on providing resources needed to conduct the testing. Testers focus on verifying that the software does what it is designed to do. The testing process requires frequent communication between testers, developers, and the product manager to report and fix defects and to verify fixes.

UNIT TESTING

Unit testing checks that the individual program unit, module, object, or set of object-related objects functions according to the requirements. This is typically done by the developer rather than the program manger or end user.

SYSTEM TESTING

System testing tests the entire system, from beginning to end, from the user's perspective.

USER ACCEPTANCE TEST

The last step in the testing process is user acceptance testing. This is performed by one or more user representatives to confirm that the software works correctly and is usable before it is formally delivered to the end users. User acceptance testing should also include reviews of any associated documentation, such as user manuals. The user acceptance testing should take one to two weeks.

DEPLOYING

The manner of distributing and deploying the application will depend on the number of intended users, whether the application was designed for a single user operating on a personal computer or for simultaneous access by multiple users running on a central server –or as a web-based application. There are many possibilities. In all cases, the users of the software (program officers, data entry specialists, IT managers) need to be trained on the functioning of the software and on how to complete their tasks as it related to using and maintaining the software. For this purpose, a detailed user's guide and on-line help features are very useful. In deployment, routine back-ups of data and even hardware maintenance need to be part of the work plan.

Part of the deployment process is training users on how to operate the system. This can be done through structured on-the-job training or through competency-based trainings. Training materials can be developed during the building and testing phase, i.e. the user acceptance test does not need to first take place. If the training materials are developed at the same time, then the deployment stage can take three to four weeks.

MAINTAINING AND UPGRADING

Most C-LMIS implementation activities deal with the ongoing and never-ending tasks of fixing and enhancing existing applications. When faced with enhancing the application with a significant upgrade, the system is really undergoing a new cycle of development. All steps described above regarding development of the LMIS also apply to upgrades and should be followed accordingly.

Tracking of exceptions or bugs –and user ideas for enhancements and upgrades are needed for continued successful operation. If the system is to operate over an extended period of time a live database of bugs and enhancements using a web-based program like Bugzilla will help your software developers to keep track of and to prioritize user requirements.

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APPENDIX A: COUNTRY CASE STUDY

An African country completed an initial design of their ARV drug logistics system in April 2006. The logistics system was initially designed as a two level, forced ordering, pull system, and sites submitted monthly report and order forms directly to Logistics Officers at the central level. At the time of the initial implementation, no tool existed to assist with the aggregation and analysis of reported data. Because of this, reported data was not being used for logistics decision making, like analyzing national and site level stock status and planning for procurements.

As a temporary measure, some Excel spreadsheets were developed. These sheets allowed for the aggregation of consumption data and patient data and site level stock on hand data so that some stock status analysis could be completed. However, these Excel sheets quickly became unwieldy (a new Excel book was created for each month) and analysis over time was not possible.

The logistics system for ARV drugs was redesigned in June 2007, after an assessment of the existing system had been completed. As part of the system design, new consumption records, transaction records, and an LMIS report were developed. The revised system was a two level, forced ordering, pull system, but the review period was changed to bi-monthly. In addition, the data that was collected at the site level and reported to the central level were changed.

The program realized that developing and implementing a central level C-LMIS was critical to support program operations and improve overall supply chain performance. In October 2007, a user requirements gathering exercise was conducted. As the first part of this process, a vision of the system was developed, and an assessment of existing resources was conducted. This exercise was completed by a team of individuals including the following: Business Analyst, IT Analyst, LMIS Analyst, 2 Logistics Advisors, 4 Logistics Officers, the Logistics Management Unit (LMU) Manager, and the MOH Logistics Focal Person. This enabled consensus to be reached among all stakeholders about the approach and expectations to developing the C-LMIS.

Summary of Assessment:

Logistics Functions and Operating Parameters

- Commodities to be included in the system are ARV drugs (adult and pediatric) and fluconazole
- 115 facilities in the system
- 2 level system, where resupply quantities are calculated at the SDP level
- The system had been designed and was in the process of being implemented, so no changes were envisioned to be made in the next 5 years
- Facilities do not operate on a budget based ordering system, and all commodities are free of charge, so no financial information is necessary
- The existing Excel spreadsheets were limited in analysis and had become unwieldy to manage

Leadership and stakeholder involvement

- Major stakeholders were identified as: Ministry of Health (MOH) HIV Unit and Logistics Management Unit (LMU), MOH Monitoring and Evaluation Unit, Central Medical Stores, US Agency for International Development (as the primary funder for the activity)

- No feedback reports were being provided to the facility level.
- Standardized reports on logistics system performance were not disseminated to any central level stakeholders, although the LMU staff did utilize the aggregated consumption and stock on hand data from the central level to input into a PipeLine database. This national level stock status was regularly presented at Logistics Coordination Meetings.

Relationships with Other Computerized Systems

- A computerized system focused on M&E data was being developed by the M&E unit of the MOH. The data that was captured was from the M&E reports, and a limited number of logistics data were included on these reports, and so consequently was included in this computerized system. However, the logistics data included on the M&E reports was not the same as the logistics data included on the LMIS reports. This database was being developed by an individual in mySQL, an open source data management application. Since an IT Specialist and a Business Analyst were part of the core team conducting the exercise, an analysis of mySQL versus SQL server were conducted. This analysis included the following components: standard language support, security support, data protection, support and service, and pricing.
- The CMS was utilizing Navision as their Warehouse Management System, for central level inventory management and for order processing. CMS was in the process of upgrading to the latest version of Navision.
- Another US government funded agency was in the process of piloting three different site level computerized systems with a focus on the capture of service statistics and patient management data. This initiative had been ongoing for about three years, and little progress had been made. No single tool had been identified as appropriate for larger scale implementation.

Human, Financial, and Information Technology Resources

- Since the LMU is based at CMS, it was decided that the C-LMIS should be hosted at CMS
- Human resources available include: IT staff, Data analyst, 4 Logistics Officers, an Upstream Logistics Coordinator, and the LMU Manager
- It was unknown would enter the data into the system, but proposed that a Data Entry Clerk be hired for this task.
- All 4 Logistics Officers, the LMU Manager, the Data Analyst, and the Data Entry Clerk would all need to access the system at the same time. They all sit at the LMU office at CMS.
- There is limited internet connectivity at CMS. There is a server at CMS, but the server is often down and is unreliable. The LMU does not have its own server. All LMU staff have their own computers. In terms of IT environment in the rest of the country, it is extremely limited. Virtually all sites (even in the capital city) regularly do not have electricity, and a very small number have internet connections. Phone connections are very unreliable, and the cell phone network is consistently down. Only facilities at the central level have computers, and these are extremely old.
- USAID has committed $100,000 for the development of a C-LMIS. There are no other sources of potential funding at the moment.

Summary of Vision:

Logistics Functions and Operating Procedures

- The LMU wanted to develop a central level computerized LMIS for the logistics system which manages ARV drugs and fluconazole to better manage both upstream (forecasting and quantification, procurement) and downstream logistics functions (site performance, general system performance). Also wanted to computerize to detect trends in product use and patients over time, and have reported data adjusted, aggregated, and analyzed.
- The C-LMIS would be used to :
  - provide feedback to facilities on the quality, completeness, and timeliness of their reports
  - provide information to facilities on their performance relative to other facilities
  - approve resupply quantities to facilities
  - aggregate consumption and stock on hand data to assess national stock status
  - determine quantities to redistribute between facilities
  - track discrepancies between the quantity ordered and the quantity approved
  - track discrepancies between the quantity supplied and quantity received
  - monitor the central level lead time for filling orders to facilites
- Computerization was only intended to occur at the central level, as computerization at the facility level was not realistic at the time
- The performance of the system would be measured through the following indicators:
  - overall loss rate (the goal was set at 1% of the value of all goods in stock)
  - total number of stockouts at facilities (goal was set at 0)
  - number of facilities that maintain stocks between the set minimum and maximum
  - on-time delivery rate per review period (goal was set at 98%)
  - on-time ordering rate (goal was set at 90%)
  - on-time processing of orders received (goal was set at 100%)
- A system re-design or revision had just occurred two months earlier and no changes to the system, management, or organization were anticipated.
- Other products that may be integrated into the system were TB drugs and commodities.
- Data from the C-LMIS would feed into:
  - Navision (WMS at use at CMS)
  - Quantimed and PipeLine (for forecasting and quantification)

Leadership and Stakeholder Involvement

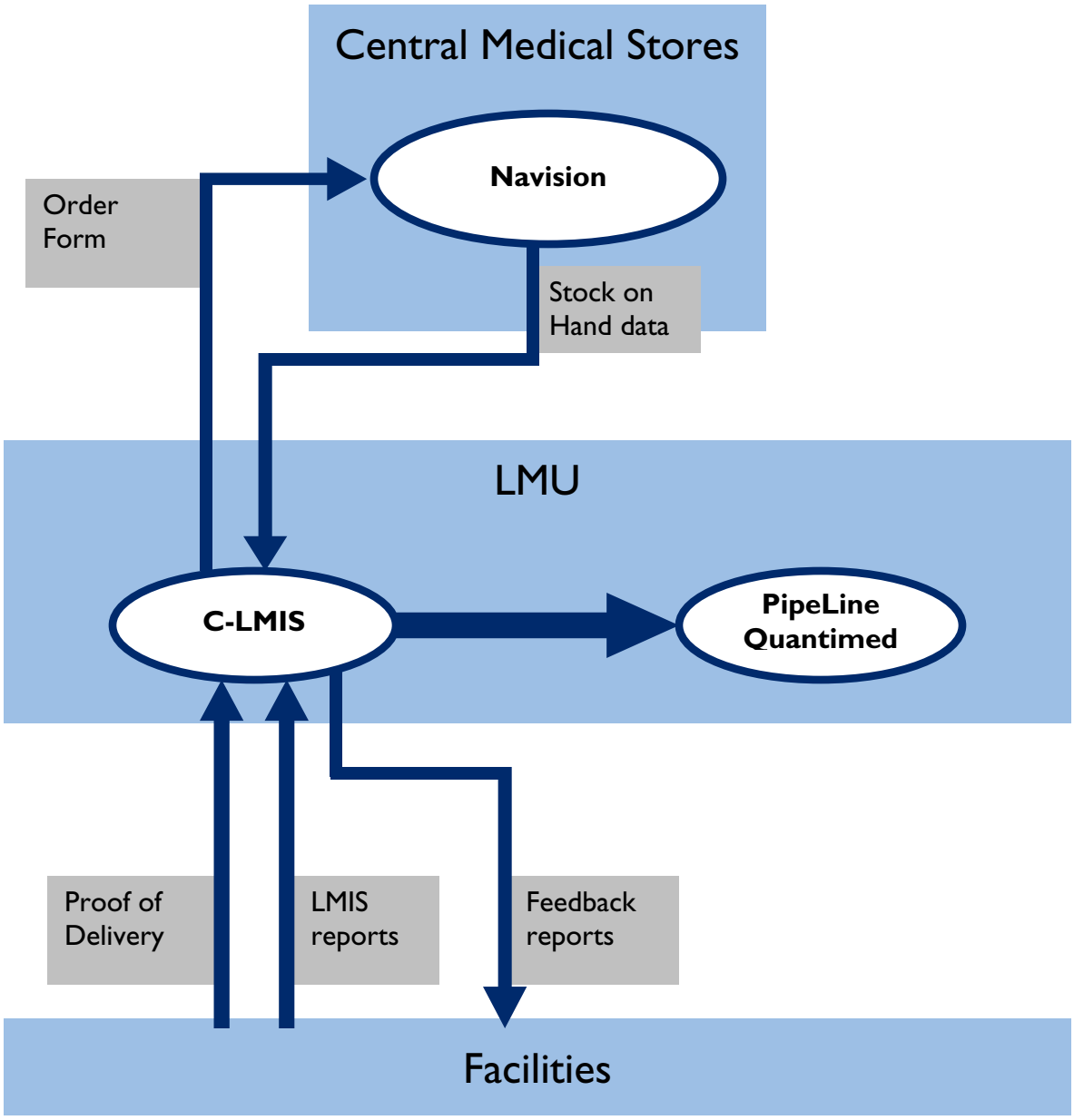
- The stakeholders that needed to be kept and informed of the process are: Ministry of Health HIV Unit (including coordinators for ART, PMTCT, and HIV testing and counseling), Ministry of Health M&E Unit, CMS, USAID and partners, and other donors to the national ART program (Global Fund, European Union, Clinton Foundation, Medicins Sans Frontiers)
- The LMU (along with USAID partners) would be responsible for the successful implementation, and would act as the champion and sponsor for the C-LMIS.
- Other than LMU staff, no other decision makers are expected to access the application directly. Rather, the Data Analyst, along with the LMU Manager would generate the reports and circulate them to stakeholders as necessary.
- The MOH and USAID are the prime decision makers to determine if the computerization project can proceed. They need information on: suggested timeline and budget, and a proposed implementation plan with milestones and deliverables.

Analysis of the Responses

The outstanding issues from the analysis of the vision and the assessment were as follows:

- Need for a server at the LMU to be procured and configured. CMS would need buy in to allow for a server at the LMU, since the LMU is based at CMS
- A job description for a Data Entry Clerk would need to be drafted, and an individual recruited for. Funding for this position would need to be secured.
- Further discussion is needed with the MOH M&E department about the purpose of the LMIS, and if and how the C-LMIS would relate to the mySQL application that was currently being developed
- Since MOH and USAID buy-in determine whether the computerization project can occur, regularly scheduled meetings should be held to update them on the progress.

A map of the flow of information (including software utilized) was drafted:



APPENDIX B: OPTIONS FOR DEVELOPING A COMPUTERIZED LMIS

There are three options for developing a computerized LMIS: in-house developers (if applicable), packaged off-the-shelf software, or the services of an information technology consultant or organization. Using in-house resources is helpful since developers are nearby and often already familiar with many of the LMIS needs. Buying packaged software is an attractive alternative for implementing computerized systems that have common features across multiple organizations and environments. Hiring an external consultant or organization may likewise be a suitable approach for clients with limited human resources or information technology skills. Previous chapters covered the steps involved in developing a computerized LMIS; those are the steps to follow when using in-house developers. This chapter provides a brief review of the latter two options, and the following chapter outlines the steps involved in buying services to develop the LMIS.

BUYING PACKAGED OFF-THE-SHELF SOFTWARE

In general, it is better to buy packaged software than to develop software, for these reasons:

- Lower maintenance costs over the long term. While the initial cost for licensing and technical support may appear daunting, the long-term costs for maintaining packaged software are lower than the costs for custom-developed software. The cost for maintaining packaged software is spread across a large number of clients, so each client's share of that cost is small compared to the cost for maintaining software developed specifically for one client.
- Faster implementations. Packaged software has already been tested by the vendor as well as by numerous clients, so unlike custom-developed software, it does not need to be tested thoroughly before implementation. It was also designed to be installed in a wide variety of client environments and includes utilities to facilitate installation.
- Access to upgraded versions of the software. Vendors continuously develop new versions of packaged software to fix identified defects and to include suggested enhancements from clients. Clients can then choose to upgrade to the latest version of the packaged software rather than spend time and resources developing custom modifications.
- Access to product and user support. When clients buy a software package, they also have the option of purchasing support from the vendor for some period of time, usually one year. This support helps address any technical problems clients experience using the software. In addition to support agreements with the vendor, clients can find answers to their questions from other users of the software, often via Internet-based discussion forums set up for that purpose.

Although all of these are powerful incentives to buy rather than develop software, even when purchasing an off-the-shelf software package some amount of customization to fit the organization's functional needs is still required. At times, customizing an off-the-shelf software can be as costly and time-consuming as custom building software.

BUYING THE SERVICES OF AN IT CONSULTANT OR ORGANIZATION

Another way to implement a computerized LMIS is to purchase the services of an outside consultant or company to custom-build a solution. JSI has used this approach in several countries: Bangladesh, Honduras, Mozambique, Nepal, Philippines, Tanzania, and Zimbabwe. (See appendix 1 for lessons learned in implementing computerized LMISs in several of these countries.) This can be an effective approach to computerized LMIS implementation in public health organizations that have limited or no information technology skills. It also allows these organizations to benefit from the skills of outside consultants or companies who have experience implementing computerized systems for a number of clients in a variety of settings.

For more information, please visit deliver.jsi.com.

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