

# A HealthTech Report

## Last Mile Informatics for Immunization Programs

*A Report on the VillageReach Health  
Management Information System and the  
Importance of Process Mapping Techniques*

July 2009



**USAID**  
FROM THE AMERICAN PEOPLE



## CONTENTS

Executive summary.....	3
Introduction.....	3
Information systems: a tool for strengthening health systems .....	4
Case study: vrMIS in Mozambique .....	6
Improving last-mile data collection and analysis .....	7
The future of vrMIS .....	13
Conclusion .....	16
Appendix A: Technical design work from detailed business process mapping.....	17
Appendix B: Roadmap .....	19

This report was made possible through the generous support of the American people through the United States Agency for International Development (USAID). The contents herein are the responsibility of VillageReach and PATH and do not necessarily reflect the views of USAID or the United States Government.

## REPORT AUTHORS

This assessment was carried out in collaboration with VillageReach. VillageReach is a nonprofit social enterprise with a mission to save lives and improve well-being in developing countries by increasing last-mile access to health care and investing in social businesses that address gaps in community infrastructure.

The report was prepared by:

James Daily, Chief Technical Officer, VillageReach

Leah Hasselback, Program Manager, VillageReach

David Lubinski, Program Advisor, PATH

Sophie Newland, Program Officer, PATH

## EXECUTIVE SUMMARY

Despite tremendous strides in the availability of new medicines, increased focus on measuring outcomes, and improvements in medical supply chains, the final segment or “last mile” of health care delivery remains the weakest component of health systems in low- and middle-income countries. Since 2001, VillageReach has worked to strengthen the last mile of medical supply chain logistics. An important part of its effort is the development of a health management information system (HMIS) called vrMIS. VillageReach’s vrMIS enables health care teams at all levels to make informed decisions based on accurate and timely information on the performance of logistics systems. Due in part to vrMIS, VillageReach innovations have been effective in **improving immunization coverage rates from 68% to 95%** in northern Mozambique, where VillageReach developed and tested the system.

PATH and VillageReach recently reviewed the second version of vrMIS with support from the HealthTech project. Two important elements have contributed to the strength of this version:

- VillageReach’s vrMIS builds on the previous version to effectively deliver information to users for evidence-based decision making. The system architecture provides access to a rich repository of vaccine logistics and immunization program information gathered directly from the field coordinators (i.e., the field personnel directly responsible for distribution of medical supplies to health facilities) which can be accessed from any computer via an easy-to-use web interface.
- The technical design of vrMIS applies software engineering practices, standards, and development tools that will enable the system to integrate and interoperate with both existing national health management information systems and those that may be designed in the future.

Two prospective improvements to vrMIS have great potential for increased functionality and usability:

- Incorporate a telephone-based data collection and query component to enable immediate digital data capture and retrieval at the time and place of service. This capability will increase the timeliness of information available for reporting from 30 days to real time.
- Add easy-to-use and robust reporting and mapping tools that can rapidly illustrate performance. Using existing standards and open source tools, VillageReach has developed a prototype of this mapping and reporting capability. The prototype gained high initial user acceptance and increased the timeliness and accuracy of data while leveraging the existing VillageReach information system platform.

VillageReach is partnering with other technology players who are able to help solve challenges at the last mile and support the rollout of vrMIS. VillageReach also seeks a strong alignment with PATH and other global efforts to design holistic systems rationally. The technical roadmap laid out in Appendix B of this report outlines the potential of this system as a platform and explores how VillageReach expects to improve vrMIS in a manner that is planned and sequential, but still retains its innovative approach.

## INTRODUCTION

### ABOUT THIS REPORT

This report, commissioned by the USAID HealthTech project, studies the ways in which a rational approach to the design of health management information systems can be applied to immunization system

development. The report examines the response of VillageReach’s health management information system to design challenges and incompatibilities within public health information systems, and provides a set of recommendations to help further develop information systems.

In a sense, this paper is a call to action for policymakers and technologists to work together to improve the quality of application development for health management information systems. Those who are developing strategies for strengthening health management information systems, especially at the last mile, are a key audience for this report. This group includes staff members at a number of international organizations such as the World Health Organization (WHO), The United Nations Children’s Fund (UNICEF), Optimize Project, and DevInfo, as well as those working in emerging mobile health (mHealth) and integrated health systems development. Private software development firms and integrators may also be interested in developing for this sector. In addition, the authors hope to convince a broader audience of the importance of investment in information systems at the last mile for public health.

## INFORMATION SYSTEMS: A TOOL FOR STRENGTHENING HEALTH SYSTEMS

Effective medical logistics and delivery systems require significant amounts of quantitative data to forecast needs, procure medical supplies, staff health centers, and monitor the impact of interventions. Timely and accurate data is particularly important to ensure adequate supplies are available to meet needs, while at the same time reducing wastage.

Ministries of health, donors, international organizations, and nongovernmental organizations continuously search for data to guide, monitor, and evaluate efforts to improve health. Rural areas are of particular concern due to their diffuse populations and great challenges. In a time of increasing demands for accountability, transparency, and data-driven health interventions, the call for data has become more urgent.

WHO has proposed a framework to define health systems and what strengthens them. According to this framework, a fundamental element of a strong health system is institutional capacity to use health information systematically. Unfortunately, this information is rarely available in low-income countries, particularly in the last mile of the health system. The lack of robust health management information systems occurs in part because countries are unable to make the significant investment necessary to build and maintain systems that can collect, analyze, and communicate information for meaningful and immediate action.

## THE ROLE AND CHALLENGE OF VERTICAL SYSTEMS

Although the focus of interest in this assessment was the application of vrMIS to immunization programs—a vertical program, the WHO framework notes—health management information systems are fundamental to the health system as a whole. Countries and donor agencies must aspire to integrate approaches for functional information systems that lead to more effective health systems. Generally, in vertical systems, information tends to flow from the top down, if it flows at all. This is an effective system when the goal is to address donors’ requirements for reporting. A vertical design offers donors and implementers the ability to focus funds and attention on collection of the specific data they need. But it places a heavy burden on health workers by creating fragmented, duplicative, and inconsistent methods for data collection, aggregation, and reporting.

Accordingly, vrMIS is designed to be applied to both vertical and integrated systems, and emphasizes a bottom up approach.

## STRENGTHENING THE SYSTEM BY STARTING AT THE BOTTOM

A few centralized health management information systems have been effective in supporting decision making at the national or provincial level, where a limited number of top ministry officials use functioning computers with up-to-date software and stable internet connections. These centralized information systems provide a high-level picture of a country's health system. It is extremely difficult, however, to extend the reach of these systems to the last mile of the health system: the rural health center.

Designed to record, analyze, and distribute relevant data, health management information systems operating at the local level have been widely promoted as useful tools for improving health care in developing countries. Yet many projects have failed to fulfill project goals, failed to become sustainable in the long term, failed to successfully scale from pilot projects, or failed for other reasons. After examining the lessons learned from many types of health management information system projects in developing countries, VillageReach noted common unmet needs:

- Technology that is appropriate for the environment.
- Stakeholder incentives and perspective.
- Support for decision making at the lowest level.
- Aggregation of regional and county-level data as an outcome, not a primary goal.

## INFORMATION SYSTEMS AND LAST-MILE HEALTH WORKERS

Health management information systems at the rural level can provide quantitative information about the effectiveness, successes, and challenges of providing health services. With well-designed systems in place, field staff have the information they need to do their jobs more effectively and efficiently. For example, a district manager who sees a report showing health center stock-out trends over time can pinpoint ongoing problems by specific health center. A health worker who sees a report listing the number of children vaccinated over the previous six months by vaccine type can identify the target group for each type of vaccine and focus social mobilization efforts on the group that is less served.

One of the biggest challenges in designing health management information systems is ensuring that information flows in two directions: Those who collect information must also get feedback to help in their frontline work. If health workers do not see any benefit from health management information systems, their motivation to provide primary data rapidly decreases. In other words, if health workers do not fully benefit from the health management information system, it can never reach its full potential.

## AN OPPORTUNITY IN MOZAMBIQUE

Mozambique has one of the world's most challenging health care environments. With an average life expectancy of 41 years and per capita total health expenditure of \$47 annually, Mozambique needs significant improvements in basic health care.

A major barrier to health care in Mozambique is the weakness of the health system and related service infrastructure in remote, rural areas. It is estimated that 63% of Mozambique's population lives in rural communities without adequate transportation, communications, and energy infrastructure. Rural residents have limited access to clean water, reliable food supplies, and health care. Most basic care is provided by small rural health centers. Delivering and maintaining a sufficient inventory of medical supplies—especially vaccines, which require a functioning cold chain—is challenging and logistically complicated in an

environment lacking basic infrastructure. When VillageReach began operating in northern Mozambique, a baseline assessment found that 80% of health centers did not have sufficient supplies of vaccines in stock (stock-outs).

The health care environment in Mozambique is, to say the least, difficult. It presents an opportunity, however, to test last-mile information systems and facilitate their development.

## CASE STUDY: vrMIS IN MOZAMBIQUE

In 2002, VillageReach partnered with the Mozambique Ministry of Health and the Mozambique-based Foundation for Community Development to strengthen the immunization program in Cabo Delgado, a province of Mozambique. The partners implemented a project that installed a system to improve vaccine logistics, supportive supervision, and information management at the last mile. At the time, the country did not collect data on the rate or patterns of vaccine stock-outs or the effectiveness of the cold chain. This situation posed a number of operational challenges in improving vaccine delivery and immunizations.

In 2004, VillageReach undertook a program to develop a last-mile solution for data collection and analysis. By 2007, the project had helped increase vaccination coverage rates from 68% to 95%. As an integral part of the project, VillageReach developed a functional health management information system that, unlike previous attempts, focuses on rural health centers and ensures frontline health workers are motivated to collect data because it provides them with information they need.

The data collection and analysis challenges VillageReach encountered in rural Mozambique illustrates the kinds of problems found in villages throughout Africa. To begin, VillageReach identified three major challenges with current systems of collecting data.

## MANAGING BY OUTCOMES PROVIDES INSUFFICIENT DATA

Current data collection efforts often focus on outcomes: number of children vaccinated, vaccination drop-out rates, and vaccination coverage rates. While quantifying and understanding health outcomes is important, a critical information gap remains. When a vaccination coverage rate is below target, immunization managers need data to find the weak points in the system that result in low coverage rates. They need to identify the districts and health centers that are not serving their target population, and to understand why. Finding the answers requires regular data reporting that shows ongoing performance of the system, not just the system's results.

Existing information systems are inconsistent, with data isolated in paper systems and long lags and inaccuracies in linking to aggregated systems. Furthermore, existing data cannot be broken down by district level and below. While staff members know the situation in their own health centers, the information does not flow up through the health system.

## CENTRALIZED INFORMATION SYSTEMS LEAD TO LOSS AND WASTAGE

Mozambique's Ministry of Health maintains a single health management information system. This centralized system simplifies the process of information management, but has disadvantages. Because the information systems department is separate from health program departments, timelines do not always align. Data pass from the health programs at the provincial level to the information systems department. The process of entering information into the system is time consuming and it often takes months to enter

and produce reports. In the meantime, planning, forecasting, and service provision activities take place based on out-of-date information.

The existing system is unable to disaggregate data below the district level. All information specific to a health center is maintained only in the minds of the health workers, and so is unavailable for planning and operating effective programs. The team that manages vaccines for the country is different than the team that provides vaccination services in health centers. The program managers have data about trends and usage that are not available to the health workers, so each group bases decisions on incomplete information. The result of this inadequate coordination of information management is the loss and wastage of medical goods.

## COLD CHAIN MANAGEMENT IS INSUFFICIENT FOR NEW VACCINES

Existing information systems in Mozambique do not monitor cold chain equipment or operation in health centers, where the cold chain is defined as the refrigeration units used in transport and storage. Currently, the only way to identify the country's cold chain capacity is to conduct a survey. When the status of the cold chain changes, as it frequently does, there is no mechanism for updating the survey database.

Timely data regarding breakdowns in the cold chain are critical to maintaining vaccine services at health centers. If a refrigerator breaks down, for example, it means the community served by the health center that houses that refrigerator has no vaccine services. If this happens often enough, the community loses faith in the health center's ability to meet their needs. Mozambique currently has no mechanism for communicating or tracking cold chain problems in the health centers.

Monitoring cold chain capacity and operation is becoming increasingly important as new vaccines are introduced that require refrigeration and are more expensive and bulkier. Any breakdown in the cold chain in the future represents a greater financial loss in this resource-poor environment.

## IMPROVING LAST-MILE DATA COLLECTION AND ANALYSIS

To improve last-mile data collection and analysis in Mozambique, VillageReach began by using a Microsoft Excel-based system that fed information into a centralized database. This system accomplished one of its primary objectives of reducing stock-outs of vaccines and medical supplies by delivering better information to health center staff and field workers.

As time went on, however, VillageReach observed that local users did not value the Excel-based system because they received no benefit from entering information. VillageReach also learned that, because Excel lacked a method of data validation and the ability to define relationships between data, it was not the best tool for the job.

VillageReach's primary objectives in the development of a second of version of the information system were to ensure that:

- Data entry clerks received feedback on the use of the data.
- End users had the reports and updated data necessary to make decisions.

Given the rural nature of the data entry locations, VillageReach needed to make sure its technical solutions were appropriate for the physical environment—that is, VillageReach could not assume users always had connectivity to the internet. VillageReach also took into account the fact that ministries of health must

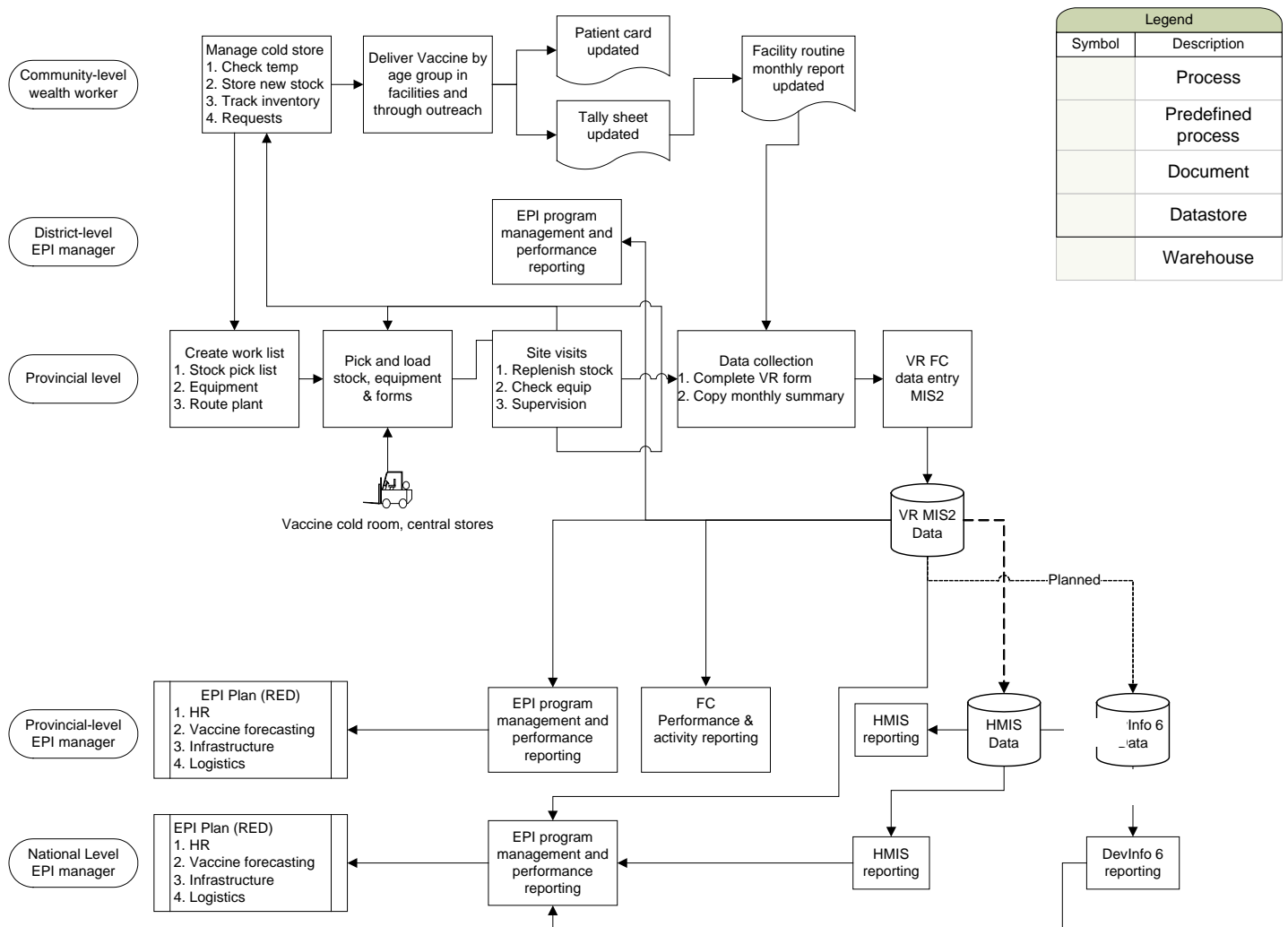
address a broad range of information system needs across many programmatic areas. A new system should be designed to integrate and interoperate with other national information systems.

### USING BUSINESS PROCESS MODELING TO DELIVER RESULTS

To build compatibility with national and global systems, VillageReach is leveraging tools and systems design approaches that are complementary to existing global efforts. WHO and the Health Metrics Network (HMN)—representing a global network of multilateral organizations, donors, private foundations, and nongovernmental organizations—have produced a framework that calls for developing model architecture to guide country implementation of plans to strengthen health management information systems.

A primary part of this model architecture is the use of appropriate standards and practices found in systems and software engineering in the global information and communications technology industry. One practice that has proven valuable is business process modeling (BPM). BPM enables stakeholders to identify and understand the relationships between people, processes, and systems. This helps to ensure information systems design and development takes into account existing ministry of health programs, processes, and systems. This is important in designing systems that are not only effective and easy to use, but that also work as complete systems and can be supported by local resources. VillageReach applied the BPM approach to illustrate and communicate the design of vrMIS.

**Figure 1: VillageReach business process map V1.4**



Applying the standards and practices from the emerging global model architecture effectively communicates the requirements and functionality of vrMIS. Figure 1 above provides a comprehensive view of the information system at a high level. It illustrates three major components that are particularly useful in communicating with national stakeholders, donors, and system developers:

- Key users
- Key processes'
- Key linkages and relationship

---

## KEY USERS

Designing any effective system begins with understanding the perspective of the users it will serve. VillageReach's vrMIS serves five key users:

- Local health workers
- District health managers
- Expanded Programme on Immunization (EPI) field coordinators
- Provincial EPI managers
- National EPI managers

---

## KEY PROCESSES

The Association of Public Health Laboratories has identified 16 key processes that comprise a typical national public health laboratory system.<sup>i</sup> In ongoing work in supply chain management systems, PATH has applied this approach and identified 16 processes that are common to any medical commodity or medication. Each of these processes contains sub-processes or tasks. Table 1 shows these processes and identifies the alignment of each process with vrMIS. Including these processes in a national health management information system benefits the country, donors, and suppliers of systems by enabling efficient acquisition of systems and minimizing overlap or redundancy of systems. By noting vrMIS involvement in a particular process, VillageReach also orients other system developers to a common framework and where interfaces would be required.

**Table 1: Typical national public health laboratory systems and associated level of vrMIS involvement**

Process	Level of vrMIS involvement
1. Demand forecasting and planning	High
2. Procurement	Low
3. Contract and grant management	None
4. Inventory management/chain of custody	High
5. Inbound transportation management	None
6. Warehouse/stores management	Medium
7. Outbound transportation management	High
8. Trading partner management	None
9. General performance reporting and management	High
10. Proactive problem alerting and notification	Medium
11. Statistical analysis and reporting	Medium
12. HR management, training, education	None

Process	Level of vrMIS involvement
13. Warehouse/stores certification	High (specifically cold chain equipment)
14. Quality control and quality assurance	High
15. Safety and accident reporting	Low
16. Disaster response and recovery	Low

VillageReach’s vrMIS extends the reach of many of these processes to the last mile. The system delivers better visibility of frontline vaccine consumption, cold chain management, and management interventions. It provides coverage of key processes to deliver timely and accurate data. As such, VillageReach is well positioned to collaborate with others involved in these public health activities.

vrMIS takes a high-level view of business processes and how those processes may be improved. For example, in Mozambique the management of refrigerators—which are essential to the cold chain—was based on data that was often months out of date. VillageReach used data captured by vrMIS on the status of the cold chain to target health worker training most effectively and to allow for real-time management of the refrigerators. Simply put, this approach places information system design at the service of strengthening the health system.

---

## KEY LINKAGES AND RELATIONSHIPS

In Mozambique, field coordinators are the central human resource of VillageReach’s approach. Field coordinators deliver vaccines and supplies, provide supportive supervision, and collect data from frontline, point-of-service sites. They report directly to provincial EPI managers and maintain important relationships with health workers and facility health officers, who look after the onsite cold chain equipment and deliver services to the community. These relationships are the critical link between resources and services and the people who need them. They make up the last mile in health care.

Field coordinators serve not only as effective links in the supply chain, but they also provide information and supervision at the point of service. They maintain relationships with managers of central stores and vaccine cold rooms, which allows them to share trends from the frontline with those involved in core supply chain management systems and gives them the opportunity to learn about availability and anticipated demand for supplies across the districts, provinces, and the country.

VillageReach’s work with business process mapping in Mozambique showed that linkages between information systems also are crucial to success. Three linkages are especially important:

1. The system gathers data from the frontline and converts it to actionable information to help decision makers at all levels, especially district managers, provincial and national EPI managers, and UNICEF and WHO EPI specialists. Access to this information is available directly within the vrMIS system in the form of an easy-to-use online reporting feature.
2. vrMIS has the ability to export all data in a variety of formats so that it can be integrated into an existing national health management information system. Because national systems are highly individual, vrMIS supports common file formats.
3. Finally, the leading reporting system for millennium development goals (MDGs) is DevInfo 6.0 (<http://www.devinfo.org/>). This system is a natural candidate for consuming vrMIS data and merging it with other data to produce analyses and reports for planning, and metrics and evaluation.

vrMIS can integrate with other health information system applications via a standards approach—for example, by sending data to DevInfo.

The current version of the DevInfo application is widely installed to provide performance reporting on MDGs. DevInfo has extensive experience in aggregating data from many systems. The data can be synthesized and represented for decision making. DevInfo supports several standards, including the statistical data and metadata exchange (SDMX). SDMX Technical Standards Version 2.0 provides technical specifications for the exchange of data and metadata based on a common information model.

VillageReach recognizes the importance and value of standards like SDMX and widely used applications like DevInfo in supporting country-level decision makers. For this reason, the architecture and strategy of vrMIS is designed to integrate or interoperate with health information system applications, such as DevInfo, using standards including SDMX.

## HOW vrMIS AUTOMATES DATA COLLECTION

vrMIS automates a paper system that:

- Tracks vaccinations for children and adults.
- Monitors vaccination inventory movement.
- Collects information on the status of cold chain equipment, such as refrigerators.

Unlike top-down systems, vrMIS starts from the premise that the logistics infrastructure—such as energy supplies for the cold chain—are strengthened dramatically by improving the data collection process. vrMIS overlays a new process on top of the existing system, much like a routing system is overlaid on top of an existing delivery service. This role is carried out by the field coordinator and is a bottom-up approach, engaging community health workers, district and provincial EPI managers, and, finally, national or international EPI managers.

To manage vaccine stocks, vrMIS provides a way to forecast demand, allowing field coordinators to take the proper amount of vaccine on a regular and predictable monthly delivery route to health centers. This makes obsolete the ad-hoc approach of “demand-side” vaccine stocking, which requires health workers to travel to a central store to requisition pre-placed stocks—often closing health centers while they are away.

To manage the cold chain, health care teams must monitor the operational status of individual refrigerators at the health centers. vrMIS provides a snapshot of the status of these important elements, and captures a log of existing or previously resolved cold chain issues. Field coordinators can use this system to ensure issues are resolved.

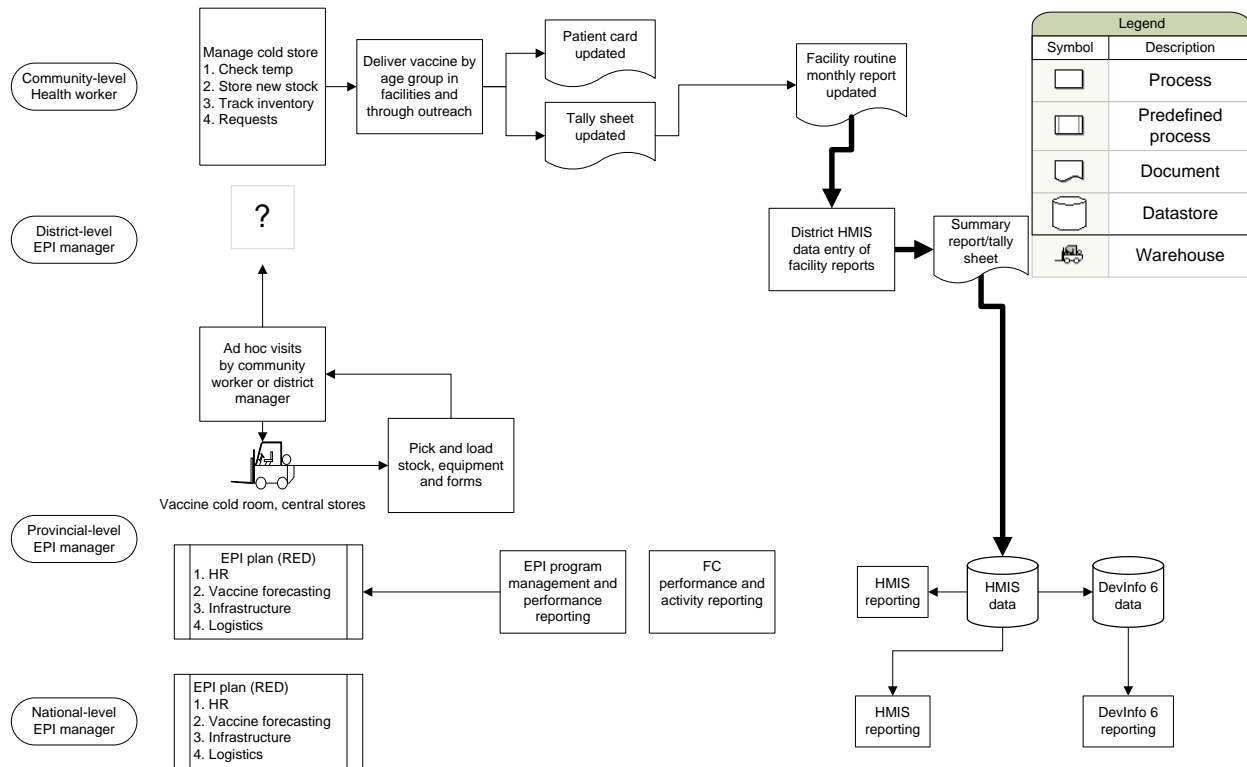
To track immunizations and manage outcomes, vrMIS measures and monitors vaccination rates for children and adults for the full range of vaccines—in real time. The information system allows users to get reports from remote locations on a monthly, weekly, or even daily basis.

On a monthly basis, vrMIS:

- Reports on the number of vaccines administered in specific demographic categories.
- Logs issues with the cold chain equipment and provides analyses of trends in issues.
- Tracks inventory changes and status of delivered supplies, stock-outs, and wastage.

To arrive at this design, VillageReach examined the process of data collection of vaccine delivery, cold chain equipment management, and maintenance of vaccine inventories in the field at all levels. As a first level of analysis, VillageReach realized that there were several ways in which improving the data flow could provide more accurate, timely data. Figure 2 represents that analysis.

**Figure 2: VillageReach Business Process Map V1.6**



In business process mapping, all steps in a process are either value-add or non-value-add. Figure 2 shows several steps, noted as thick lines in the diagram, that are not adding value to the data collection process. The figure also forecasts a time when vrMIS will allow health workers to enter data and receive information on a mobile device. In this scenario, the field coordinator role shifts to a monitoring role, and the desktop application is eliminated in favor of more mobile and lower-cost devices in the field.

**SIDEBAR: FOUR APPLICATIONS FOR FAST AND ACCURATE DATA**

VillageReach’s vrMIS consists of four related applications:

1. A desktop application that field coordinators or supervisors use to enter frontline data from recently completed visits to individual health centers.
2. A desktop application that provincial-level accountants use to track costs related to the service delivery improvements.
3. A web-based report application that allows users to analyze specific data reported monthly for each health center.
4. A central data repository that stores, manages, and represents data as information for decision making.

## LIMITATIONS AND IMPROVEMENTS IDENTIFIED BY STAKEHOLDERS

Stakeholders noted that limitations with vrMIS include a lack of integration with national health systems and reliance on an operational model that is practiced in only two provinces. Stakeholders have also noted operational issues, mainly in capturing information from new vaccines and providing a way to enter additional Reach Every District (RED) outreach data. Stakeholders have said that with the addition of a few items, the system would be an appropriate replacement for the current EPI management system.

In conversations with stakeholders in Mozambique in March 2009, the authors determined the following features would most quickly yield significant improvement to the system:

- Inclusion of a coverage rate report.
- Improvement of the online report interface to allow for more data queries and discovery.
- Improvement of the comprehensiveness of the cold chain monitoring; creation of action logs and additional reporting.
- Integration of vrMIS into the Ministry of Health of Mozambique's (MISAU's) information systems; long-term survivability of the software in Mozambique ensured.
- Extension of the functionality to support a more distributed and decentralized process as planned by MISAU (work at the district level).

## THE FUTURE OF vrMIS

### IMPROVING vrMIS IN MOZAMBIQUE

In Mozambique, VillageReach's near-term priorities for vrMIS are focused on developing new features requested by users. VillageReach also plans to make improvements in the architecture in order to take advantage of mobile phone network technologies and emerging new data devices.

In the near term, vrMIS in Mozambique could:

- Report on the number of vaccines administered to specific demographic categories and provide delivery planning and optimum stock calculations. This requires a more flexible set of concepts in the data model and other changes to the base infrastructure.
- Log issues with the cold chain on nearly a real-time basis, track issues through resolution, and help ensure medical quality of vaccines and other medicines. Currently, devices in developed-country cold chains provide time-based temperature tracking. These devices could be "read" by a properly equipped mobile phone, which could transmit a temperature log for specific items as they make their way through the cold chain. Similarly, devices could log temperatures of specific elements in the cold chain, such as refrigerators.
- Track inventory changes and status and generate bulk orders on a district basis. Commonly used logistic concepts, such as location and inventory numbering, could become the basis of automation, with the mobile phone as the data transfer vehicle.
- Add a phone-based collection system that leverages text messaging and smart phone-based forms. VillageReach is developing a prototype to demonstrate how short message service (SMS) messages could make their way into the database of reported status.

While these processes are important for VillageReach’s efforts, a fundamental development imperative is integration or the ability to interface with other health systems. If vrMIS is poised to become a definitive platform for the last mile, it also must become part of a larger national health management information system.

The main technological problem in this area of health informatics is not a lack of systems, but a lack of cohesive system integration methodologies. This situation is due in part to systems that are designed in a vacuum to fit a specific, single-stakeholder purpose, or to fulfill specific vertical requirements. VillageReach expects to build a new model for system development, and ultimately to leverage other platforms or become part of the common platform for the last-mile solution.

## THE ROADMAP FOR vrMIS

In addition to the improvements VillageReach is making to the system used in Mozambique, it has identified four areas of planned development:

1. Enhance user experience. This includes changing the data model and adding online reports to make better use of operational data.
2. Extend the architecture with an SMS (or text message) front end, smart phone data forms tool, and offline webforms. This improvement will help ensure the applications can operate in an environment where data may come from multiple devices or data-gathering processes.
3. Develop logistic system interfaces to accommodate levels of integration. vrMIS is best aligned with logistic systems that already exist. vrMIS could be a consumer of data from such systems and could also send data to the systems in a structured manner. Related improvements include examining the use of common logistic tools, such as barcode scanners, radio frequency identification (RFID), and global positioning systems (GPS), that are built into mobile applications.
4. Ensure applications follow best practices in quality assurance and alignment with business processes. The ability to adjust and change the system over time, while incurring few risks, is vitally important.

To be successful, each of these areas has dependencies and component developments that must occur in sequence. For more information please see the Roadmap in Appendix B.

## LEVERAGING DATA STANDARDS IN vrMIS

To be successful, improvements to vrMIS must integrate with other systems via data and protocol standards. There are multiple proprietary logistic systems, but none constitutes a gold standard. As a result, standards are based on data communication protocols that allow different systems to interact.

For VillageReach, using logistics standards will largely consist of accurately capturing the concepts found in logistics—such as inventory management, warehousing, and outbound management—and leveraging the data standards found in embedded devices and communications between different logistic systems. For example, the standards developed by the International Standards Organization (ISO) for logistics include many that apply to barcoding as part of a larger effort toward automated data capture. For example ISO/IEC 15419:2009, as defined by International Standards Organization in 1996, describes the characteristics and defines categories of bar code digital imaging systems as part of an automatic

identification and data capture technique within logistics data capture and monitoring systems, while there are other ISO standards to define testing and quality assurance of bar coding. <sup>ii</sup>

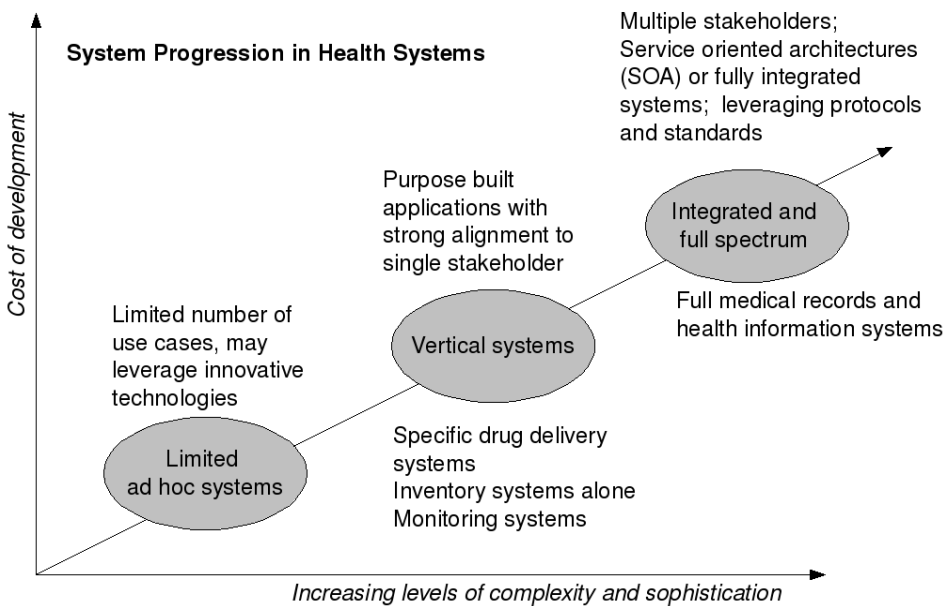
Standards in public health are not enforced on a commercial basis, but there is guidance from WHO and others about some topics, including the use of electronic medical records and immunization reporting. This guidance often includes a set of customary data elements, and thus, a data standard. At times, specific systems become the standard to which all other systems communicate. The list of approved refrigeration unit types is also a standard and potentially leads to better data within known operating characteristics. The implication of all of these health systems standards is that commonly used forms, found at health centers globally, provide a useful starting point for data capture requirements.

**THE LINK BETWEEN VILLAGEREACH’S SYSTEMATIC APPROACH AND GLOBAL EFFORTS**

The emergence of mHealth applications is creating new opportunities and pointing out many of the challenges with traditional, single-purpose information systems in public health.

In Figure 3, the progression of health management information systems is shown as a linear function of increasing cost on one axis and increasing sophistication and complexity on the other. In many public health systems, progression has halted at the second stage. The result is an overabundance of “endless beta,” that is, the development of innovative approaches that are never made available globally in a manner that can be sustained over the long term.

**Figure 3: Progression of health management information systems**



## CONCLUSION

VillageReach’s experience in Mozambique provides evidence that health management information systems—and specifically vrMIS—have great potential to strengthen health systems and delivery:

- Health management information systems are a critical component of functioning health systems and contribute to improved health outcomes. There is greater need for these systems as global demands for accountability, transparency, and data-driven health systems increases.
- Health management information systems can significantly strengthen the health system at the last mile, where most people in low-income countries live. Health workers at the rural level are often ignored by information systems, but they can vastly improve results if they have data on which to base their decisions. Health workers value quality data—if they benefit from it. Furthermore, data for health services planning at local, national, and international levels originates at the point-of-service, making accurate and timely information of vital importance. The last mile for health care delivery is the first mile for data.
- Last-mile health management information systems must be designed with the appropriate technology and architecture to be successful in a very challenging environment.
- Health management information systems must be designed to integrate with local and global information systems.
- The business process mapping approach is an important tool in building information systems that create efficiencies in workflow and enable integration and inter-operability with existing and future national health information systems.
- In Mozambique, vrMIS is solving several vital data processing automations, and the opportunity exists to achieve further efficiencies.
- By adding four features, including a phone-based data collection system, vrMIS could integrate more effectively with local and global systems and information systems, providing wider usability and furthering evidence-based decision making for improved health outcomes.

---

## END NOTES

- <sup>i</sup> Association for Public Health Laboratories. Requirements for Public Health Laboratory Information Management Systems. A Collaboration of State Public Health Laboratories, the Association for Public Health Laboratories and the Public Health Informatics Institute; 2003. Available at: [www.aphl.org/aphlprograms/informatics/pages/default.aspx](http://www.aphl.org/aphlprograms/informatics/pages/default.aspx). Accessed June 20, 2009.
- <sup>ii</sup> International Organization for Standardization. Automatic Identification and Data Capture Techniques. 1996. Available at: [www.iso.org/iso/iso\\_technical\\_committee.html?commid=45332](http://www.iso.org/iso/iso_technical_committee.html?commid=45332). Accessed June 28, 2009.

## APPENDIX A: TECHNICAL DESIGN WORK FROM DETAILED BUSINESS PROCESS MAPING

The following diagrams provide a starting point for system software design.

Field coordinators interact with the system on their desktops, recording information from the field. Web users interact with the system via a login and make requests of the system for information. Each key decision point for the system operation is highlighted to ensure that software developers understand when processes are event-driven or data-driven.

**Diagram 1: Starting point for system software design**

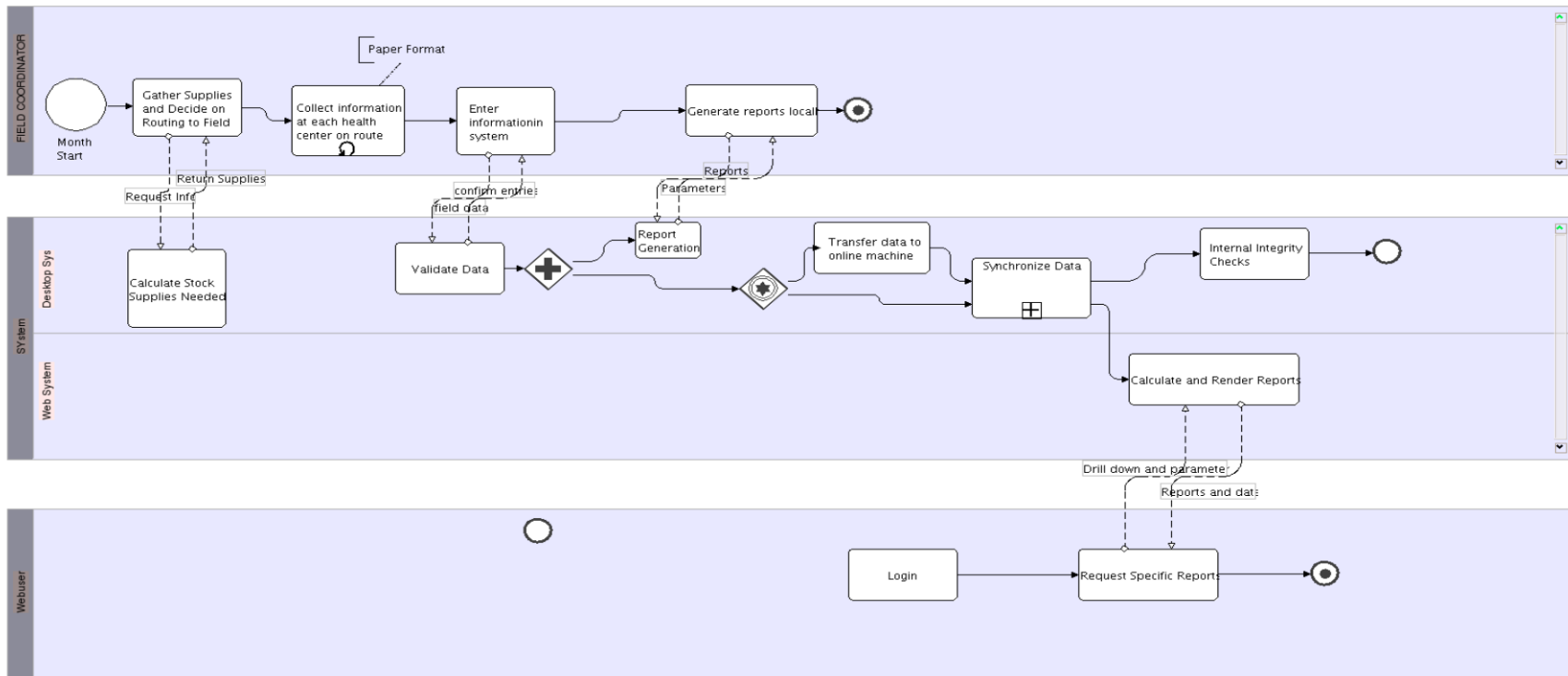
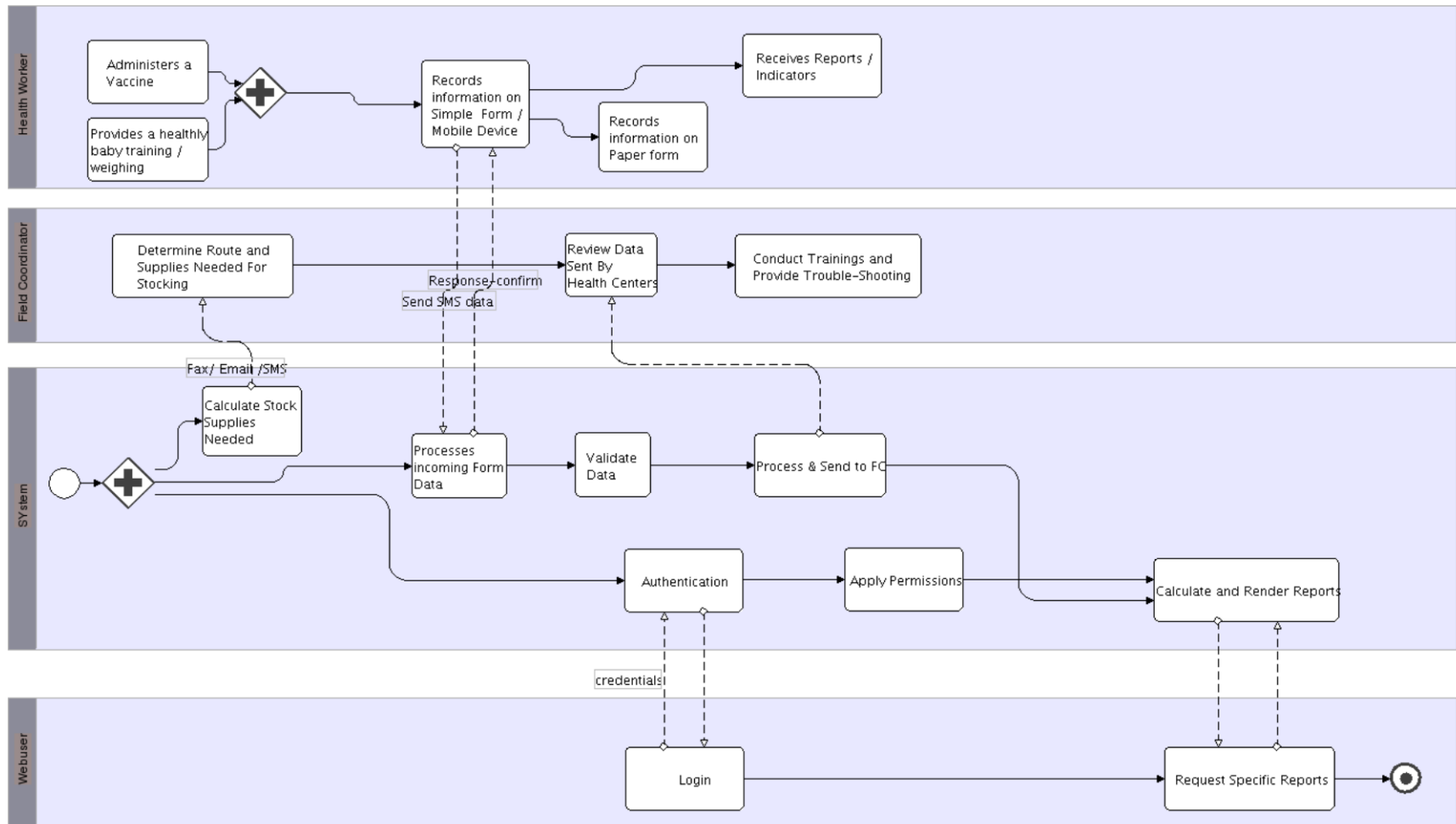


Diagram 2: A set of processes to show the use of a mobile phone application



## APPENDIX B: ROADMAP

| -- Future development phases over time →  
Q1 Q2 Q3 Q4 Q5 Q6 Q7

### *Enhancements to current applications for key stakeholders*

Complete online report and data discovery enhancements (mapping)

Complete key functionality around RED

Add to and revise centralized data model for forward compatibility

### *Extend architecture with SMS front end and offline webforms*

Design multiple data source model and componentize

Develop general data model with additional layer of abstraction

Manage events for transaction system interfaces

Create SMS forms and java download for mobiles for all key forms

Partner with SMS two-way gateway provider for robust networking

Develop browser-based forms with google gears offline

### *Develop interface models for logistic systems*

Add location aware data (GPS) to SMS transport on smart phone forms

Revise and extend data model for interfaces based on standards

Manage events of further development into workflow engine

Develop interfaces with two key logistic systems

Implement SMS-based barcode or scanner concept on smart phone

### *Ensure quality assurance and process alignment*

Add automated testing for quality assurance

Model as aspects fully in BPM standards compliant software

Publish API for external sources of data

Conduct regular security review and improvements

