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USAID DEMOCRATIC REPUBLIC OF CONGO (USAID/DRC)

MIS/GIS Assessment

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Implemented by:
Development & Training Services, Inc. (dTS)
4600 North Fairfax Drive, Suite 402
Arlington, VA 22203

Phone: +1 703-465-9388
Fax: +1 703-465-9344
www.onlinedts.com

USAID/ DRC
MIS/GIS ASSESSMENT

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Executive Summary

This assessment was initiated in response to increased USAID recognition of the potential benefits of geographic information system (GIS) technology to the international development community and the establishment of a Geospatial Center based in USAID/Washington. USAID/DRC has identified spatial analysis as a powerful tool in achieving the Mission's development goals and objectives, and believes that GIS tools can improve not only the quality of its development planning, but also improve collaboration between implementing partners and other donors.

1.1. Introduction

The management information system (MIS)/GIS strategy employed in this assessment is intended to: 1) provide a high-level view of how geospatial data, tools and skills should fit within the mission, 2) define the role MIS/GIS should play and its relationship to MIS, and 3) design a roadmap for establishing a high-quality MIS/GIS system for USAID/DRC. A key component noted several times in this assessment is the need for a commitment to MIS/GIS from USAID and from the Mission Director and leaders. USAID has started to make investments in MIS and GIS technology that the recommendations depend on. For implementation of MIS/GIS at the Mission level, championing of the MIS/GIS must come from the top down to ensure staff and partner commitment.

This assessment examines and provides recommendations on the value that geospatial information and technologies could add to the achievement of USAID/DRC's development goals and objectives. The objective is to present: 1) arguments/reasons why the Mission should implement an MIS/GIS, 2) arguments/reasons against implementing an MIS/GIS, and 3) resources needed for design, implementation, and ongoing maintenance of an MIS/GIS.

1.2. Key Findings

The scope and requirements for an MIS/GIS were developed in consultations with USAID/DRC's program offices and technical teams, drawing on experience from existing USAID-funded and other related GIS implementations. In gathering requirements, on-site interviews were conducted with Mission staff. Key individuals in other USAID-affiliated organizations where GIS systems have already been implemented were also consulted.

Information gathering meetings with Mission staff resulted in the following principal findings:

- Teams do not use electronic databases to track program activities.
- Operational data is generally provided to technical teams by implementing partners in a manually compiled, non-standard, textual format.
- There is no mission-wide activity or project management database that could be utilized as a back-end data source for an eventual GIS system.
- None of the technical teams has data sets that measure impact.

- There were several common mapping needs identified by all teams:
    - A need to know and map where all implementing partner activities are taking place to help allocate resources.
    - A need to know where other donors programs and activities are located in order to better plan for synergistic activities.

Analysis of the current state of data collection processes and data estates found:

- There is a wide variety of practices for the collection of data related to performance indicators.
- Project and activity data reporting suffers from a lack of accuracy and timeliness, and requires excessive back-and-forth communication.
- Existing data stores by technical teams are not linked and are not updated automatically.
- Without significant data validation and verification, Mission staff cannot be sure that data sets they are using for project and activity reporting are complete, timely, or accurate.

The implementation of an MIS is fundamental to improving the timeliness and accuracy of requests for information on Mission and implementing partner activities.

A study of existing MIS/GIS implementations by other USAID Missions and other donor organizations provides context for further research. MIS/GIS initiatives are categorized into three groups: Advanced GIS, MIS-Based GIS, and Ad Hoc GIS. The first two groups are instructive in showing how a well-planned MIS with a GIS front-end can evolve into a system that provides utility beyond what was originally conceived. An analysis of the Central Africa Program for the Environment (CARPE) system shows how a thorough data organization phase was necessary to establish a basic system that eventually allowed system users to really discover the potential of a GIS. CARPE subsequently evolved into a well-recognized Advanced GIS system.

1.3. Recommendations

This assessment details many potential benefits of MIS/GIS for USAID/DRC. The most compelling benefits include the improvement of donor coordination and the ability to effectively tell the Mission's story. Some other benefits include:

- Strategic planning through the use of demographic and infrastructure layers.
- The evaluation of funding proportionality between regions and sectors.
- Summary reporting and drill-down of data to a detailed level for ad hoc analysis.
- Viewing the distribution of implementing partners in regions.
- Evaluating project effectiveness compared to previous projects in the same area or in areas with similar socio-economic or demographic variables.
- Viewing relationships between project data and a variety of data sets including: socio-economic, demographic, education and health; land use,

agriculture, soils, forestry, biodiversity, climate and availability of water; location of schools, markets, hospitals and other significant social constructs.

- Understanding the historical effects of USAID or other development projects.

The recommendation of this assessment is to utilize a five-phased approach as the only practical method of achieving an MIS/GIS capability in the long term. The approach allows the Mission to build upon successes and ensure that each step is fully operational before expanding to the next step:

- **Phase 1** Organize required data sets and assign specific spatial relationship to data.
- **Phase 2** Implementation of MIS using data sets defined in Phase 1.
- **Phase 3** Implement GIS for simple, standardized maps based on existing MIS data.
- **Phase 4** Incorporate other (donor) data and mapping layers into GIS.
- **Phase 5** Create advanced applications and capabilities with GIS technology.

Many missions have already developed and implemented their own MIS components with mixed results. The recommendation for the MIS component for DRC is to not re-invent the wheel and to utilize an existing off-the-shelf/software-as-a-service MIS application. USAID M/CIO/KM is developing a Mission Portfolio Management System (MPMS) which can serve the function of an MIS and is recommended by this assessment. An MPMS will soon be in pilot phase at two missions and a gradual production roll-out is expected in 2012. There is already a waiting list of missions wanting an MPMS, so an interim solution may be desired. Two interim alternatives are presented that could be immediately available and easily transitioned when/if the MPMS becomes available. The Environmental Systems Research Institute (ESRI) software suite is recommended as the GIS component. It is generally considered the 'government-accepted' GIS, is the market leader, and has been identified by the USAID for potential enterprise licensing.

The implementation of an MIS/GIS will require organizational change management; implementing partners will need to change the process they use to submit data; COTRs will change the process in which they validate and accept data; and staff will change the way they report data.

Since the recommendation for an MIS is for software-as-a-service, required infrastructure investment is low payment is generally required as services are used. For the GIS, a one-time investment in GIS technology and servers is required. Several roles were identified for implementation of an MIS and a GIS; these roles may be served by existing staff members, vendors, or new hires. The roles do not necessarily correspond to direct staff numbers.

Some of the next steps recommended include:

- Form a core team in the mission that will oversee and provide guidance of the implementation of the MIS/GIS.
- Engage the USAID M/CIO/KM MPMS about becoming a candidate for early implementation of MPMS.

- Determine if an interim MIS solution is needed based on availability of an MPMS system.
- Determine who will work with partners to explain purpose and train them on use of the system.
- Engage the USAID GeoCenter early, informing them of plans for MIS/GIS and be put on their radar for products and services they will offer to missions.

2. Overview

This assessment was initiated in response to increased USAID recognition of the potential benefits of GIS technology to the international development community and the establishment of a Geospatial Center based in USAID Washington. USAID/DRC is focused on utilizing the power of GIS mapping to help achieve development goals and objectives and believes that spatial analysis of its activities can help in the planning stages and that GIS can be a useful tool for collaboration between various implementing partners.

GIS provides a commonly understood and powerful framework for collecting, organizing and managing data. A wealth of data can be displayed and clearly summarized on maps. Simple thematic maps can be produced showing potential areas for overlap or gaps in current program coverage. Data from most sectors can also be collected to add depth to spatial analyses; transitioning from thematic maps to in-depth project analysis. Socio-economic, demographic, health, education, agricultural or environmental sectors can be analyzed individually or together to detect spatial and temporal trends that are difficult or impossible to detect on spreadsheets. Analysis of current and future strategies, programs and projects can be performed to help target at-risk or neglected populations.

2.1. Background

dTS is providing monitoring and evaluation (M&E) services to USAID's Democratic Republic of Congo (DRC) Mission Office. The USAID program in the DRC is fully integrated into the U.S. Government's (USG) diplomatic efforts to foster peace and stability within the DRC and in the region, and complements the $300 million annual USG contribution to the United Nations Peacekeeping Operation (MONUC) in the DRC. The overarching strategic vision for U.S. Foreign Assistance for the period between 2009 and 2013 is to support the security conditions and governance structures that will foster improvements in social and economic sectors and allow state authority throughout the DRC to take hold. USAID/DRC supports programs in conflict mitigation; demobilization, disarmament, and reintegration (DDR); good governance, human rights, social protection, education, food security, humanitarian assistance, livelihoods, and health. With an increased budget and an increase in the number and scale of Mission-funded programs, there is an increased need for adequate performance monitoring and evaluation of activities to measure and report on program results and impact.

Over the past year, Administrator Shah and the U.S. Congress have called for USAID to improve the focus of mission portfolios, to renew their emphasis on monitoring and evaluation, and to continue transforming development through the use of science and technology. Innovative ways to design, monitor, and evaluate development projects are particularly important for missions where a targeted approach to addressing development challenges is required because of a limited budget and large socio-economic and education disparities between regions and within rural and urban populations.

USAID's Missions have long called for an MIS to support planning, management and reporting required by their projects and activities. A key aspect of Mission MIS needs

is the ability to link project and activity results to investments and to use geographic mapping to display data and results. The availability of geographic information within a Mission is consistent with one of the seven key focus areas of the USAID FORWARD Reform Agenda and would support learning by measuring progress and accomplishments. The utilization of geospatial analysis via a GIS is an effective way of increasing development impact and simultaneously addressing the priorities of the Administration and the Congress.

A GIS integrates hardware, software, and data for capturing, managing, analyzing, and displaying geographically referenced information; it can be used to create, analyze, and display multiple "layers" of mapping data, such as political boundaries, urban areas, forested areas, elevation, agricultural zones, population density, or per capita income, allowing the user to "see the big picture" and therefore make more informed decisions.

2.2. Assessment Objectives

This assessment evaluates the potential of USAID/DRC's use of geospatial information and technologies, determines resource needs, and provides recommendations accordingly. The goals of analysis are: 1) to offer arguments and reasons both for and against Mission implementation of an MIS/GIS, and 2) to estimate the resources needed for the design, implementation, and ongoing maintenance of an MIS/GIS.

2.3. Assumptions

The MIS/GIS strategy employed on this assessment was developed to provide a high level view of how geospatial data, tools and skills should fit within the Mission, the role MIS/GIS should play and its relationship to MIS, and a roadmap for achieving the desired state. This recommended strategy is based on the current state of technologies available, and should not be considered to be cast in stone as available technologies are evolving rapidly. The recommendations and strategies should be reviewed and revised periodically to maintain a focus on opportunities and pitfalls that become apparent in the future.

A key component noted several times in this assessment is the need for a commitment to MIS/GIS from USAID, from the Mission Director and agency leaders. USAID has started to make investments in MIS and GIS technology that the recommendations depend on. For implementation of MIS/GIS at the mission, championing of the MIS/GIS must come from the top down to ensure staff and partner commitment.

Given the scope, breadth, and gaps between all possible data sources – existing and currently non-existent – that could be utilized to help achieve Mission objectives, it is unlikely that the Mission would have sufficient resources to address all needs and desired capabilities identified by technical teams. Likewise, at this time it is impossible to envision all possible capabilities of the envisioned GIS; however, as the components of the system are implemented more uses will become apparent. This document is intended to create an MIS/GIS roadmap and help the Mission

clarify how and where resources can be best targeted, and in which action areas the Mission should concentrate to develop a successful MIS/GIS framework that meets both near-term and long-term needs.

2.4. Assessment Sections

This document is organized in the following sections:

GIS Assessment Tool/Methodology: Defines the methodology for performing the MIS/GIS assessment, which was developed in coordination with approaches identified by the newly established USAID Geospatial Center (GeoCenter) and other USAID GIS initiatives.

Requirements Analysis for Mission-level GIS: MIS/GIS scope and requirements for the development, implementation, and maintenance of a Mission-level GIS designed in consultation with USAID/DRC's Program and Technical Offices, and drawing on existing USAID-funded or USAID-affiliated GIS systems.

Assessment of Current Data Domain: Assesses data currently collected by USAID/DRC, and implementing partners (IPs) in terms of frequency, means of collection and delivery, data entry and archiving. Assesses data standards for the recommended MIS/GIS. Identifies data potentially available from other donors, NGOs, the GDRC, and other organizations.

Comparative Assessment of Existing USAID MIS/GIS Implementations: To guide further research, an assessment of existing MIS/GIS implemented by other USAID Missions and Bureaus, USAID-affiliated organizations, and other donor organizations.

Recommendations and Roadmap: Recommendations as to 1) whether USAID/DRC should implement a GIS, and 2) the form and scope of an eventual GIS, based upon a forward-looking assessment of USAID requirements likely in place by 2013/14. 3) Design of a phased roadmap for implementation of the recommended MIS/GIS.

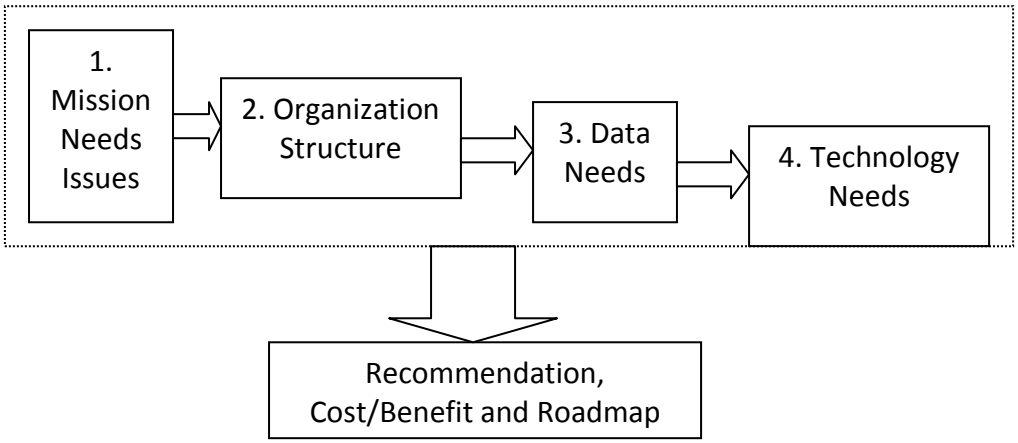
Resource Needs for Implementation and Maintenance: Based on the requirements analysis, a draft design, implementation, maintenance plan and schedule of resources needed for the MIS/GIS lifecycle.

3. GIS Assessment Tool/Methodology

For any IT system implementation, a GIS in particular, it is important to define a strategy and business case to ensure that a future implementation is aligned with objectives and that the desired benefits are attainable. Unfortunately, when implementing systems, many novices focus on the technology first, this usually results in the subsequent strategy not meeting the business need.

In order to assure that business needs are addressed and an appropriate supporting data infrastructure is developed, this assessment utilizes methodologies specific for a *spatial system development strategy*, wherein each sequential step in the process, from business need to technology needs reveal requirements to be addressed in each subsequent step. This cascading approach helps ensure the design focus starts from real business needs and drives toward a holistic solution, and does not become simply a technology evaluation.

The steps of the methodology are outlined below:



Mission Needs/Issues: Review current Mission objectives and programs. Analyze objectives of each of the technical teams (regardless of technology). Review any automated systems. Review data collection processes, M&E reports and other captured data.

Organizational Structure: Analysis of Mission and technical teams' organizational structures and how they interact, particularly related to the impact on data gathering, integration and quality of data across parties. Emphasis on creation/capture of data, data maintenance, and organizational arrangements to support a GIS concept.

Data Needs: Review of data environment for Mission and technical teams. Analysis of data needs and data holds that have potential for GIS. Identification of data gaps. Analysis related to GIS data standards.

Technology Needs: Identification of GIS issues related to organizational databases, data presentation requirements, data integration issues and integration with potential MIS/GIS. Develop initial guidance for developing functional requirements.

Cost/Benefit Analysis and Roadmap: Using captured requirements as basis for analysis to identify potential benefits and potential pitfalls. Develop menu of options and roadmap for implementation. Analysis of broad costs including organizational, hardware/software, infrastructure, data conversion/capture, and potential system development.

4. Requirements Analysis for USAID/DRC MIS/GIS

The scope and requirements for the development, implementation, and maintenance of a possible Mission-level GIS were developed in consultations with USAID/DRC's program offices and technical teams, as well as from drawing on experience from USAID-funded and other GIS implementations. In gathering requirements, on-site interviews were conducted with Mission staff, as well as key individuals in USAID-affiliated organizations that have implemented GIS:

Needs Assessment Interviews: Interviews were held with representatives from each of the technical teams. The interviews lasted one hour and included between one and six representatives from each team.

During the interviews, information was compiled on:

- **Technical Team Profiles:** An overview of the team's organization, their programs and objectives, and relationships with their implementing partners.
- **Data Sources Identification:** of any data source or particular sets that are compiled or managed by the team. Also, identification of any data sources known to exist that could be useful with a GIS tool.
- **Potential GIS Functionality:** Any function currently completed using other methods, or not currently implemented, but could be addressed using a GIS. Identification of any information that would be better presented graphically.

4.1. Mission Office Findings

Investigation on the findings from the requirements of the individual technical teams provided the following key findings:

- Based upon information gathered through technical team interviews, it is clear that mission staff is anxious to embrace GIS technology, and look forward to maximizing the benefits offered by a mission-wide MIS/GIS.
- Teams do not maintain an electronic database that tracks program activities. Operational data is generally provided to technical teams by implementing partners in a non-standard, textual format, though generally in electronic form. These data are manually compiled into quarterly reports without any standard procedures or timing rules.
- Likewise, there is no mission-wide activity or project management database that could be utilized as a useful data source for a back-end to GIS technology.
- Outside of standard PMP outcome reporting structure, there does not appear to be much commonality in specific data sources between each of the technical teams. Each team has its own project objectives and its individual resulting data sets do not provide much value to other teams at the atomic level. However, on an aggregate level, there would be value in the consolidated view of all the data sets providing a broad picture of all of the mission activities in the region.

- None of the technical teams has data sets that measure impact. Any available data is solely related to activity outputs. It is clear that any future solution would need to be flexible enough to capture impact data if/when it may be available.
- Though each team identified mapping needs specific to its activities, there were several common mapping needs identified by all teams:
    - A need to know and map where all implementing partner activities are taking place to help allocate resources.
    - A need to know where other donor programs and activities are located in order to better plan for synergetic activities.

The next sections provide a summary of the findings from each of the Mission offices investigations.

4.1.1. Program Office Findings

Team Objectives and Programs

The program office supports and advises technical and support teams on strategy development, planning, monitoring and evaluation, reporting, budgeting, programming, and impact assessment.

Data Needs and Sources

- Collecting performance data in a standard way – like Morocco – could provide timely consolidated reporting. Data can link with financial review and then link to impacts. Eases burden on implementing partners and program office to collect, sort, and analyze PPR data and produce reports.
- Strong desire to be able to coordinate with other donors and with GDRC.
- With a new strategy under development for 2013, it is hoped that GIS can be a centerpiece of that new strategy.
- Development of important, meaningful indicators are an important next step in consolidating data for a future MIS.
- Good quality data from implementing partners will be vital for the success of the MIS.

Potential GIS Application

- Display USAID and other donor activities and where they are taking place to determine overlap and synergies.
- Show impact of programs in simplistic manner.
- Develop ad hoc report requests.
- Share data and information with donors in order to engage and share strategies.
- Share information with other USG agencies to leverage results.

- PMP support to show impacts on top of standard indicators in the future.
- Reporting maps to show investments in health, economic growth, education, etc., vs. impact over long periods of time.
- Help plan the location of future investments.
- Support for cost/benefit analysis of projects to reach desired impacts (achievement vs. cost).

4.1.2. General Development Office: Peace and Security and Social Protection Findings

Team Mission and Programs

Increase stability by mitigating the causes and consequences of conflict. Stabilization and conflict management as well as disarmament, demobilization, and reintegration activities are designed to mitigate ongoing conflict, with the long-term goal of extending state administration and basic social services to the entire national territory. Programs involve:

- Monitoring the intensity of security incidents.
- Minimizing the level of damage from security incidents (early warning protection systems, etc.).
- Building social cohesion and minimizing community tension.
- Reintegrating former combatants (and child soldiers) back into communities.
- Reducing human trafficking.
- Future programing may include a community and livelihood program encompassing agriculture development projects, schools, refugee integration.

Data Needs and Sources

- Measurements of incidents and where team is providing assistance.
- Currently collecting outputs, but will need to begin to focus on impact in the future.
- How to reconcile timeliness of data with planning. (Example: Funding for cell phone towers become available one year after security incident reported may no longer be relevant.)
- Metrics are difficult in the peace and security field. (Example: Does an increase in rape mean more people are now willing to report it, or is there an actual increase?)
- The Humanitarian Information Unit at the State Department has a mapping team that will create one-off maps that may be a source of useful data.

Potential GIS Application

- Need to look at the synergies of what USAID is doing with whom and where, as well as results.

- Divide and map country into 515 health zones as well as in accordance with the Congolese equivalent of political and municipal zones.
- As reference tool: click on a health zone and see which donors work there, and where there are physical interventions.
- Expose gaps and overlaps in service provision in health zones.
- Track who is delivering post exposure prophylaxis (PEP) kits, location of supply chain and who is being trained.
- Overlay locations of projects and security incidents.
- Overlay locations of cell phone towers, high frequency radios, and incidents.

4.1.3. Democracy and Governance Office Findings

Team Mission and Programs

It is necessary to strengthen core governance institutions and build the new decentralized institutions mandated in the constitution. Programs support the creation of an effective and equitable justice system, promote good governance, protect human rights, fight corruption, strengthen independent media, promote civic participation, enhance political competition, and build the capacity of the legislature to function effectively and in consultation with a range of stakeholders.

Data Needs and Sources

- More qualitative data rather than outputs.
- Impact data is difficult to obtain unless the implementing partner does a survey, which is time consuming and difficult to analyze. Many times results are not relevant to programs and not useful to measure for timeframes less than five years. It is wasteful to do a survey once a year since there's little year-to-year change. Need 5-10 year measures and an MIS that can support long-term data storage and tracking.
- Need realistic benchmarks for any changes within two-year cycles.
- Hard to do if implementing partner is no longer involved after a project has ended.

External Data

- WGI World Bank Governance Index gives general status of governance, rule of law, etc.
- Transparency International Index.
- Freedom House Index.

Potential GIS Application

- Map changes of impacts over time.

- Need to know location of all USAID programs.
- Need to know objectives and location of all donor programs.
- Locations of joint programs with the government (where is government and partners).

4.1.4. Health

Team Mission and Programs

Improve the basic health conditions of the Congolese people by increasing their use of primary health care services and products. Improve the quality of health care and strengthening the capacity of government, the private sector, and civil society. Programs seek to reduce maternal, infant and newborn disease and death; respond to infectious disease threats including tuberculosis, malaria, and HIV/AIDS; increase access to family planning services; rehabilitate essential health infrastructure; and increase access to potable water.

Data Needs and Sources

- Need baseline data for mapping of health zones some of which may come from the UN's demographic and health data.
- USAID/DRC is taking over the health center working group for donors who desire to establish a "who's doing what, where" database. This information could also be useful for MIS
- Demographic Health Service (DHS) is trying to get provincial level data.
- The Expanded Program for Immunization identifies where diseases are.
- Potential providers of data: CDC, DOD, UN, WHO, FDA, UNFPA, UNICEF, World Bank.

Potential GIS Application

- May be of use in planning cross-sectoral programs.
- Helpful to map, plan and manage immunization efforts, bed net distribution, and other national health initiatives.
- Tracking malnutrition rates across the region.
- PEPFAR programming mapping.
- Commodity distribution mappings.

4.1.5. Education

Team Mission and Programs

As a result of civil war, conflict, and the collapse of the social sector, school enrolment rates and the overall quality of education in the DRC have dropped dramatically. USAID activities have promoted access by reducing school fees and improved the quality of basic education by training teachers and providing learning materials. The introduction of innovative methods such as interactive radio instruction and student-centered learning has increased student attendance and achievement and improved teacher performance and effectiveness. Programs also promote community participation in school management with an eye toward increasing attendance, particularly among girls, and reducing conflict by addressing corruption and exclusion of vulnerable groups.

Data Needs and Sources

- M&E data is output-based and of limited value for planning; there will need to be a shift toward impact, or outcome-oriented indicators to be useful.
- The system should be able to host data from past programs.

Potential GIS Application

- Location of implementing partner activities and accomplishments.
- Project activities vs. background demographics of region (such as sexual and gender-based violence, SGBV).
- Map to help new Mission staff and implementing partners learn where work is being done.

4.1.6. Economic Growth

Team Objectives and Programs

Increase agricultural productivity in order to restart the rural economy, and strengthen micro-enterprises to link small and medium-sized enterprises to market opportunities. Build the technical, organizational, and administrative capacity of key agricultural policy and research institutions throughout the country. Programs help to improve the environment for doing business through policy and regulatory reforms and for promoting public and private investments in transportation and energy.

Data Needs and Sources

- Data is currently spread among implementers and not of sufficient granularity to support planning and management. Data collection needs to be strengthened at the production level in agriculture programs.
- Nutrition information should be overlaid with agriculture mapping and data to aid planning.
- At the moment, data collection is very difficult and requires tremendous coordination and effort. A centralized MIS will help to ease the burden.
- International Food Policy Research Institute (IFPRI) is attempting to consolidate data. This maybe a source of some data as implementing partner data is limited to management activity and outputs.

- Want decentralized local groups to collect, manage, and maintain market information and use themselves. A web-accessible MIS will aid this effort.

Potential GIS Application

- Mapping areas experiencing food insecurity and donor locations. The EU may be a source for this data as they have a spreadsheet of agriculture sector donor activities and locations.
- Mapping of disease occurrences would be useful.
- Integrate Central Africa Agriculture Development Program investment plan data to show where resources should go.

5. Assessment of Current Processes and Data Estates

An assessment of the current data collection processes and evaluation of data estates is important in identifying what is being used to evaluate results and to uncover the issues and obstacles in collecting this data. In relation to the needs identified by the technical teams, gaps in the data collections become evident. From a higher level, the entire data estate, including databases and structures that exist, needs to be analyzed to determine how they might support a potential MIS/GIS.

5.1. Current State: Data Collection and Reporting

There is no single electronic database that tracks mission project activities or outcomes. Operational data is generally provided to technical teams by implementing partners in a non-standard, textual format, though generally in electronic form. These data are manually compiled into quarterly reports without any standard procedures or timing rules. Of the data reported, even if there is geographic information at all, it is not reported in a standard way:

- Data that drives and supports project and activity management and reporting is stored using a variety of non-standardized protocols, including off-the-cuff reporting systems.
- There is a wide variety of practices for the collection of data related to performance indicators, a key data point for projects and activities, which are communicated and reported to Mission COTRs. These practices cause redundant work on the part of Mission staff, an ineffective use of time that is required to compensate for the lack of automated systems.
- The timeliness and accuracy of project and activity management data reporting to Mission and Agency management is often lacking and requires a lot of back-and-forth communication to complete the reporting task.
- Data stores at the technical team level are not linked and are not updated automatically. Mission staff cannot always be assured that the data sets they are using for project and activity reporting are complete, timely and/or accurate without significant data validation and verification.

The end result of reporting is that narrative-style data represents a significant portion of the information available for reporting of projects and activities. The construction and maintenance of narratives is time-consuming and does not lend itself to standardization or dashboard-like structures that support “at-a-glance” or exception monitoring. An automated, data-centric solution would support standardization in the reporting of projects and activities, their schedules, status and results.

5.1.1. Current State: Requests for Information Process

The level of effort required to satisfy a special request for information (a “data call”) is significant not only for Mission staff, but for partners. In response to a request for information, Mission staff will often contact partners via telephone or email and request data on a specific project or a series of projects or activities. Partners will then assemble the data requested and send the data to the Mission. Once received

by the Mission, this data is often re-keyed into another document before it is reviewed, validated, edited and formatted to be sent to the original requestor. Figure 1 provides an overview of the business process associated with a request for information at the Mission level as related to a typical project or activity in the Mission portfolio.

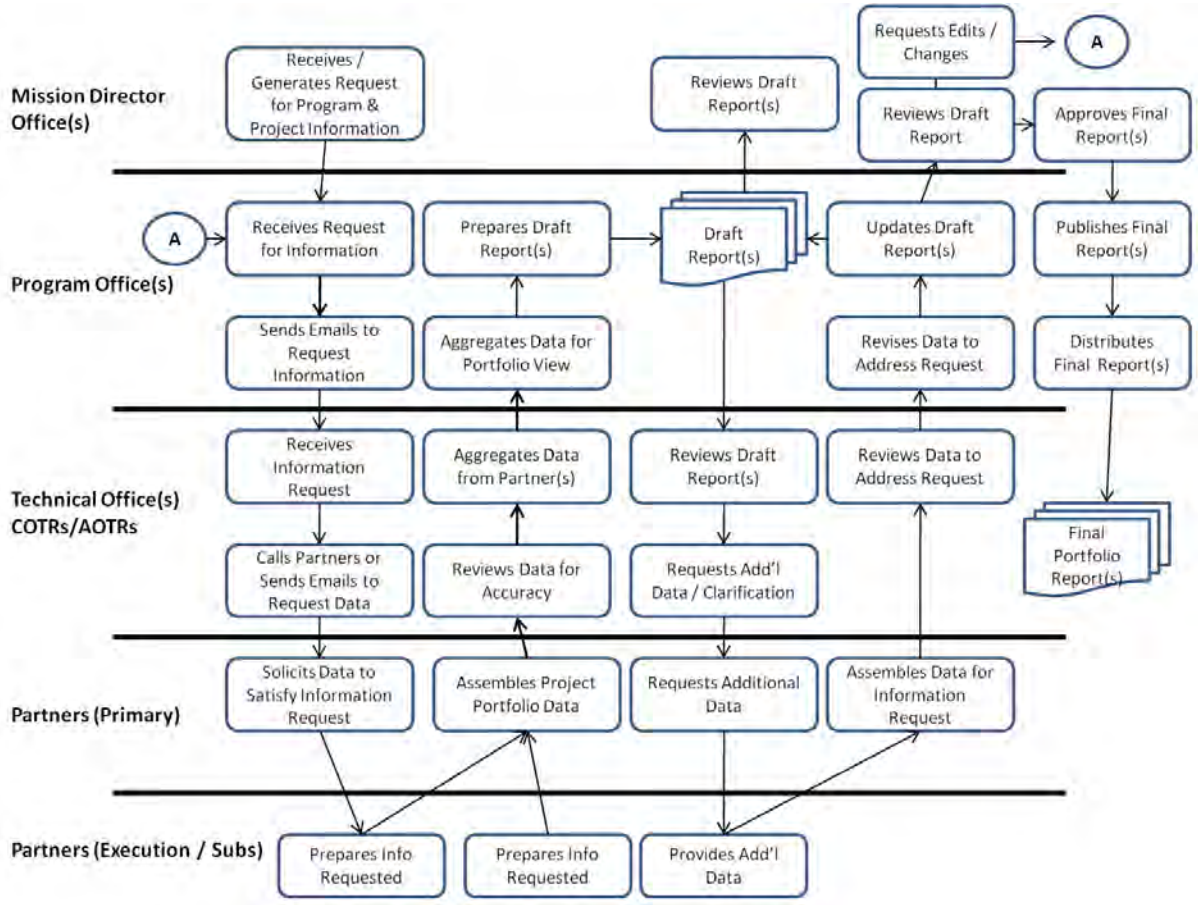


Figure 1. Current State Information Requests *(source: USAID CIO/KM MPMS Requirement Analysis)*

The benefits of a mission-level MIS can clearly be illustrated in this one process, which occurs frequently. An MIS would at the very least reduce the number of tasks required in the request for information process, mostly by eliminating redundant manual data gathering and reduced lines of communication. Figure 2 depicts how the request for information process could look with an MIS implemented that stores project and activity data using standardized procedures. Since the implementing partners and COTRs continually update and maintain the centralized database, the program office could potentially send a direct query to the database to obtain information without the need to re-engage the partners or technical teams.

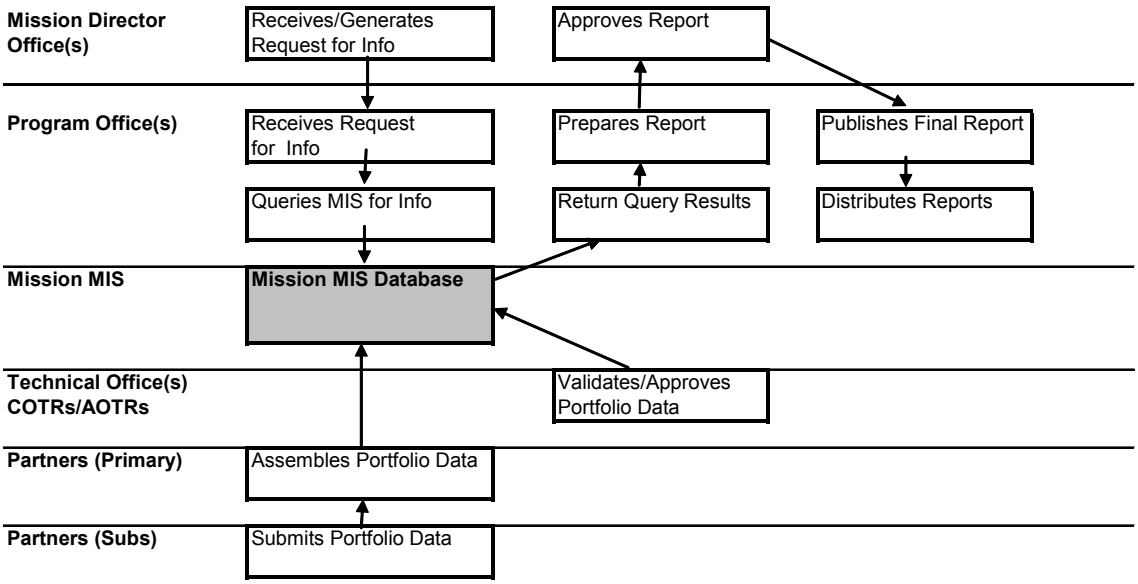


Figure 2. Simplified Request for Information Process with MIS Installed

6. Comparative Assessment of Existing USAID MIS/GIS

A study of MIS/GIS implementations by other USAID Missions and Bureaus, as well as USAID-related and other donor organizations is useful to provide context for further research. Over the years, a number of USAID Missions have made substantial investments in developing isolated project and activity management information systems and/or geospatial mapping capabilities with various degrees of success or failure.

A recent MIS/GIS assessment in USAID missions found at least 10 missions at various stages of implementing GIS; the missions' systems were not integrated with Washington or each other, and each system cost roughly $500,000 to build from scratch.

USAID currently has no centralized facility or program for map creation, though around 10 to 15 missions have a full-time staff person or a contract organization to provide such services. As a result, USAID's Economic Growth, Agriculture, and Trade Bureau has started structured initiatives to help to enlist GIS to measure and manage missions' portfolio of activities, particularly in the area of natural resource management (detailed information of these activities included in other sections of this document).

This section provides a review of several major MIS/GIS initiatives at USAID missions and USAID-related organizations. The objective of this review is twofold: 1) learn from the experience of other missions' attempts at MIS/GIS, and 2) utilize any capabilities from other missions where possible. Most of these systems provide functionality for a single Mission, often limited to a subset of the Mission's activities. The resulting maps are often pulled from ad hoc data sources such as spreadsheets. These informal systems generally do not integrate with other USAID applications or databases. Further, none of these systems facilitate the sharing of data and information among missions, a best practice that is essential for a learning-focused organization. There is no coordinated system at USAID that provides a comprehensive MIS/GIS capability, which encourages these "one-off" systems to proliferate.

For purposes of this assessment, the MIS/GIS initiatives studied from other missions and organizations are categorized into three different groups. The categorization of these groups are instructive to their applicability for meeting USAID/DRC MIS/GIS needs:

Ad Hoc GIS: GIS implementations based off a single data source for a specific purpose or one-time use. The mapping database is not a standard operational database, is not maintained or supported on a regular basis, and generally not integrated with other information systems. While valuable, these "one-off" implementations have limited expandability. They do serve a single intended purpose, but are not a robust model for an eventual USAID/DRC MIS/GIS environment.

MIS-based GIS: These implementations use an operational information system as the data source backbone for the GIS. The data source is a relational database, supported, updated, and maintained by operational processes and can be integrated with other data sources. At the Mission level, such systems can be used for basic

mapping and geographic information on projects and activities. They provide basic GIS mapping capabilities, but are limited by data and by the predefined nature of the queries implemented in the system. It is recommended that USAID/DRC would take a similar approach, which also keeps the door open to future expandability.

Advanced GIS: These are implementations that have initially been built upon an MIS back-end (MIS-based GIS) and have matured to incorporate advanced functionality: modeling and advanced analysis, incorporation of satellite measuring devices, and other more complex features. These systems generally include data interfaces or feeds to sophisticated GIS tools to enable improved insight into their project planning efforts, including assistance in determining optimal geographic distribution of activities. These implementations are instructive in that they have usually evolved out of a well-formulated strategic plan to have a foundation to integrate advanced tools and capabilities. An eventual mission-based MIS/GIS for DRC should use these systems as a model that allows for future expansion and growth.

6.1. Review USAID and Donor GIS Initiatives

A summary of some major GIS initiatives follows:

6.1.1. Advanced GIS

The following GIS implementations are considered to be very mature GIS implementations with advanced capabilities. They are instructive in that they were able to evolve into advance applications because of careful planning and long-term strategies that looked at the organizational objectives as a whole rather than attempting to address a single issue.

6.1.1.1. Central African Regional Program for the Environment (CARPE)

- Very mature implementation of GIS
- Achieved advanced capabilities
- Phased approach to success instructive for USAID/DRC

In the area of forest management and conservation, CARPE tracks illegal logging and deforestation trends in a forest that serves as a massive carbon storage reservoir for regulating global climate. CARPE works with EU, MONUSCO, Netherland Development Cooperation, and French environmental facility. Implementing partners collect data locally (on disc using Excel). Data is consolidated in an Access database and sent to the University of Maryland for entry into a database. This is then presented in a set of online tools for public consumption called the CARPE Info Management Tool, Mapper, and Data Explorer. This system uses ArcView GIS software installed at the Mission to render maps. This highly developed system was created in phases:

First Phase – Data – Deciding how to collect, standardize and view data.

- Took three years to design data collection and standards – built process into grant agreements as part of work plans.

- 35 implementing partners had to be trained (and retrained) on how to collect data. Specific indicators with means verification developed.
- Needed to centralize data collection with a standard method and tool.
- Could only start visualizing mapping possibilities after data collected in database.

Second Phase – Mapping

- Rudimentary maps at the beginning, mostly landscapes.
- Expanded maps as time went by and data collected.
- Introduced measured concepts of percentage completed and percentage defined.

(Information provided from on-site interview with John Flynn, CARPE Director USAID)

6.1.1.2. Uganda Devtrac

DevTrac is a Ugandan initiative led by a consortium of government and donor agencies: including the GEO-IS Working Group, OCHA, Uganda Bureau of Statistics and UNICEF who work together to visualize and monitor the status of national services (schools, health centers, water points, etc.) and development projects.

Traditional data collection methods often struggle to capture timely, reliable data and display and disseminate it in meaningful ways. Data is seldom shared between organizations, and rarely made public. Even worse, community workers on the frontlines and beneficiaries rarely receive feedback or even have access to this critical information. Innovative uses of new and existing technologies have already proven that these issues can be addressed effectively. Key to this is a simple and publicly available tool to bring together, synthesize and visualize a diverse array of information and data. DevTrac is being designed for just this purpose, bridging the challenges of data collection and dissemination.

Through a combination of innovative data collection mechanisms, such as turning mobile phones into community reporting and information management tools, and efforts to improve connectivity to marginalized populations through locally appropriate hardware such as rugged computers and digital doorways, DevTrac will merge traditional and real time data, while providing viewers the opportunity to simultaneously observe, inform themselves and contribute to this knowledge base.

Functionality of DevTrac will eventually merge several layers of information and data:

- A backdrop of basic socio-economic/demographic data.
- Key infrastructure points (health facilities, primary schools, water points, etc.).
- Status of key infrastructure data points with real time data (ex-functioning/non-functioning water points).
- Monitoring reports from communities, local governments, NGO and UN staff.

(Information provided from USAID websites)

6.1.1.3. Famine Early Warning Systems (FEWS NET)

The Famine Early Warning Systems Network (FEWS NET) is a USAID-funded activity that collaborates with international, regional and national partners to provide timely and rigorous early warning and vulnerability information on emerging and evolving food security issues. FEWS NET professionals in Africa, Central America, Haiti, Afghanistan and the United States monitor and analyze relevant data and information in terms of its impacts on livelihoods and markets to identify potential threats to food security.

Once issues are identified, FEWS NET uses a suite of communications and decision support products to help decision makers act to mitigate food insecurity. These products include monthly food security updates for 25 countries, regular food security outlooks, and alerts, as well as briefings and support to contingency and response planning efforts. More in-depth studies in areas such as livelihoods and markets provide additional information to support analysis as well as program and policy development.

FEWS NET uses imagery collected by NASA's Landsat program, and it can be used to monitor land use change, crop health, and potential famine conditions. The FEWS NET web site (www.fews.net) is the activity's primary global vehicle for disseminating information. Regional and national monthly food security updates appear on the site along with other information and technical materials.

(Information provided from USAID websites)

6.1.2. MIS-based GIS

MIS-based GIS solutions are generally built with mission goals and results as a main objective rather than the creation of mapping tools. The GIS layer is simply an added tool to help the Mission manage program performance. In this context, a central MIS database is implemented to serve as back-end to the GIS for displaying spatial data. This is instructive for DRC in that, to support the entire mission, it is desirable to have a centralized repository that can be built upon and expanded in the future.

6.1.2.1. Morocco

Over the past year and a half, USAID/Morocco has been building its geospatial capabilities to better collect data, and design and monitor its development projects. The mission's long-term goal of building a GIS resulted in the launch of the Activity Tracking and Mapping System (ATMS) in June 2011.

After the events tied to the "Arab Spring" and the promise of constitutional reform in Morocco, it is more important than ever to understand where and how USAID projects are affecting local governance and civil society. The ATMS serves an important role in tracking the Mission's impact by quickly and clearly creating maps and tables of the locations and results of program activities. For instance, the ATMS will show where civil society and local governance programs focus their training and workshops while also keeping track of the number of participants at each event. To further assist program managers, the ATMS database tracks information at several different levels, the most specific of which is the commune level (equivalent of a county in Morocco). As a result, the ATMS will provide program managers in

Morocco with information on citizens' confidence in their local governments, and provide a useful monitoring system for tracking the progress made by civil society organizations in developing their advocacy capacity.

Implementation of ATMS helps it more efficiently plan, monitor, evaluate, and report on program activities, as well as generate maps and reports to monitor and evaluate data-driven project design. ATMS is a web-based MIS that collects and manages project and activity reporting data for the Mission:

- The system, which includes 120 activities, offers a web-based ArcGIS interface for partners to log in and enter information including a project's start and end dates and its location.
- It can track indicators and reflect the impact of an activity throughout a region.
- ATMS is a first step in a longer-term process that includes enhancements to develop its reporting functionality and track implementing-partner activities.
  (Information provided from Karl Wurster, USAID/DRC)

6.1.2.2. USAID/Mali

USAID/Mali is focused on utilizing GIS mapping to help achieve development goals and objectives and better coordinate work with the Government of Mali. GIS is used as a planning tool and as a useful tool for collaboration between various partners. USAID/Mali is currently utilizing GIS/geospatial technologies as an essential strategic tool to help our mission to better plan and achieve our development goals.

Recently developed maps created at USAID/Mali mission include:

All Partner Activities in Mali by Communes: A map showing the concentration of presence of various USAID/Mali partners throughout the country of Mali broken down by commune, indicating where USAID/Mali partners are most active. They have also overlaid the "166 Most Vulnerable Communes" onto the map for comparison purposes. This gives guidance as to whether USAID/Mali activity coverage areas are in line with the government's own development priorities. Most of the 166 vulnerable communes are in the northern regions and also the northwestern area of Mali.

Health Program Partner Activities Map: Shows USAID/Mali Health Program partner activity coverage throughout Mali. This health map is a planning and collaboration tool for various partners to work together in more complementary and synergistic ways to meet overall health objectives/results, ensuring USAID/Mali's health programs are aligned with the USG/GHI principles.

Seeds Projects: Intensive GIS mapping and surveying for agro-dealers and seed producers in Mali.

Education: Data to assist education system planners and decision makers understand whether existing education sector strategies help to close the gaps between socio-economic classes.

(Information provided from USAID websites)

6.1.2.3. West Bank/Gaza

This is the most functionally advanced of MIS-based MIS/GIS, where GIS is needed for security activities. West Bank/Gaza MIS/GIS is a web-based system that:

- Enhances tracking, monitoring and evaluation, analysis, planning, reporting, and mapping of thousands of activities implemented by different partners.
- Integrates coordination between engineers in the field and managers in the office.
- Makes information available to Palestinian Authority and public about USAID activities – tells the story.
- Responds to requests from Congress, State, etc.

Types of Data in System

- Activity related (entered by partners via Internet).
    - Strategic objective (SO), location of activity, coordinates, description.
    - Implementing partner, local contractor, recipient.
    - Dates, cost, beneficiaries.
    - Pictures and success stories.
    - Activity type, linked to SO/sector/program component.
    - Output indicators by activity type
- Oversight Reports.
    - Date, activity being visited, problems, success, comments/recommendations.
- Demographic and sector-related data.

Geo-MIS Uses:

- Activity Management.
- Monitoring.
- Reporting and presentation.
- Analysis.
- Partner planning.

Geo-MIS includes:

- USAID activities: 9,000 activities implemented by 60 partners, representing five SOs, 100 programs, valued at $800 million (direct cost).
- Monitoring info: 200 activity types, 600 indicators, linked to the Mission Intermediate Results (IRs) and program components.
- Demographics: Statistics on most Palestinian towns.
- Spatial data: 22 layers of USAID activities, water bodies, roads, cities, villages, camps, security wall.

Cost of Development and Operations:

- Development: $500,000.
- Yearly maintenance: $30,000.
- Staffing: Two full-time.

(Information provided from various sources including USAID websites)

6.1.2.4. Lebanon

USAID/Lebanon is expanding its capacity to adequately monitor and evaluate its country program by launching the performance management program for Lebanon (PMPL) to design and implement a comprehensive performance measurement, planning, monitoring, evaluation, and reporting system.

The PMPL is improving USAID/Lebanon's ability to manage its portfolio, to report on results, and to communicate impact to stakeholders through five activities:

- Establishing a country program portfolio-wide performance management plan (PMP), a tool required by USAID regulations for planning, communications, and managing assistance, that defines indicator baseline data and targets for each strategic objective and intermediate result.
- Harmonizing implementing partner data collection and reporting in alignment with the PMP.
- Establishing an Integrated Web-based MIS/GIS) that will have dual functions both as outreach feature on the USAID website where the public can click on a map and see USAID programs, and as an internal tool where implementing partners can submit their PMP data via email and USAID staff can gather information and generate reports.
- Supplementing USAID staff in conducting site visits to monitor program activities.
- Conduct project evaluations and other special studies.

(Information provided various sources including USAID websites)

6.1.3. Ad Hoc GIS

While ad hoc implementations' functionality provide utility usually based on a narrowly defined set of issues, they provide more of a proof-of-concept guidance for a USAID/DRC MIS/GIS since DRC is focused on solutions that empower the entire Mission. These types of GIS implementation are not very instructive to USAID/DRC objectives, so investigative effort was limited for this report. The following is a list of ad hoc GIS initiatives with information available on USAID mission websites:

Haiti

In the immediate aftermath of the January 2010 earthquake, a wide range of federal agencies in Haiti collected geospatial data—including details on land slope and drainage; ownership patterns and use; road networks; and geological fault lines. The only way that the entire breadth of data could be practically managed was by incorporating it into a GIS. The result was a series of maps that showed areas where

Port-au-Prince residents made homeless by the earthquake could be temporarily relocated.

Nepal

To ensure strategic decisions for determining focus areas of Feed the Future (FTF) programming, USAID/Nepal's GIS unit designed and prepared a comprehensive set of spatial information products, categorized under themes ranging from biophysical to health to markets to socio-economic. The team made this geospatial knowledge base available to the mission before the actual program design began. This spatial analysis helped in understanding the challenges of the country and in building spatial cognitive strength among the members. USAID/Nepal now has a more focused FTF strategy. This has enabled the mission to factor climatic resources, markets, and malnutrition information into its strategic decision making.

Afghanistan

USAID has used GIS in Afghanistan to improve and encourage farming techniques for legal crops.

Ivory Coast

Ivory Coast has several GIS initiatives:

- Tax assessment and collection in Abidjan boroughs by combining geo-information on information on land, population, and economic activity.
- Placement of new village health care centers based on population locations.
- Improved allocation of revenues local jurisdictions with more precise info of size and boundaries of nearby forest concessions.

Mozambique

GIS is used to determine spatial distribution of land mines for removal and safe passage.

Senegal

GIS used with census data and village location data monitors progress of national poverty alleviation program.

Gambia

GIS used with land use data combined with human settlement information to determine waste disposal facility sites.

South Africa

GIS used with data on population centers, rivers, roads, mountain ranges combined to delineate boundaries of electoral wards for 1999 elections

Yemen

Yemen has several GIS initiatives:

- Customized health GIS analyses and the implementation of health information systems (HIS) in pilot health centers.
- Maps the distribution of governorate-specific projects by type and spatial patterns of outbreaks of Rift Valley Fever in 2000.
- Integrating HIS with GIS has improved data collection efficiency and provided a method of evaluation and monitoring for evidence-based health care pattern improvements.

Russia

Russia has several GIS initiatives:

- Monitoring of assistance to Russian orphans–maps showing aid to individual orphanage centers and partnerships with the provincial governments.
- Tracking the Eurasia Foundation's use of $10 million in USAID civil society grants.
- GIS was also linked to demographic information purchased from the Russian statistical bureau. When this data was entered into the missions GIS, mission managers were able to visualize youth "bulges" and see the population concentrations in relation to local instability and unemployment levels.

7. Recommendations

International development is intrinsically a geographic-based activity, taking into account the differences between places. Donor programs work in specific places for specific reasons and have geographic impact. By utilization of geospatial technologies, donors can analyze socio-economic, demographic, health, education, agricultural, or environmental data to highlight spatial trends that are difficult to detect on traditional two-dimensional reports.

The implementation of a mission-wide MIS/GIS will provide USAID/DRC with its own powerful set of tools capable of supporting comprehensive planning and management. A fully functioning and well maintained MIS allows for the development, maintenance and sharing of consistent and accurate data among projects. It also provides the ability to integrate multiple external data sources for analysis, and provides the mission with a management and planning tool for sustainable and smarter impacts. A functional GIS can benefit mission strategies and increase the ability to target at-risk and neglected populations. GIS tools will also enhance the presentation and communication of these observations.

A more detailed analysis of the benefits and challenges for MIS and GIS at DRC follows.

7.1. Benefits of MIS/GIS for USAID/DRC

If implemented properly, a combined MIS/GIS at USAID/DRC can provide a large range of tangible and intangible benefits. Individually, the MIS and GIS technologies each offer their own set of benefits at each stage of implementation – benefits can be realized long before completion of the full architecture. The most immediate benefit from the implementation of the MIS technology is that the mission would have a well-maintained centralized repository of project and activity data that can be queried as needed and facilitate preparation of required reports. This automation would effect an improvement in data quality, increased data collection efficiency, improved timeliness, and greater availability of data.

The implementation the GIS component builds upon the MIS data availability and query capability to provide an effective visual display of data and provide an effective management and communication tool within the mission, between technical teams, and with other donors. Simply put, a GIS is a map with a database underneath, or, it is a database that you can display on a map. The database can be manipulated to respond to different sets of "what if" scenarios; the user can make unique maps that reflect each scenario. The maps can be easily shared among users, thus facilitating collaboration and communications.

The combined MIS/GIS will provide a large range of tangible and non-tangible benefits to the mission:

7.1.1. Program and Project Planning and Design

Development challenges relating to education, economic growth, democracy, and peace and security are not constant throughout DRC. As development experts and projects planners, the Mission is responsible for knowing the details of each region in

order to design and implement development projects. The use of geospatial analysis using demographic, education, economic, and other relevant data collected by various institutions and implementing partners will facilitate this process and contribute to a well-rounded understanding of the development challenges. Analysis of development variables within a GIS for project/program planning can then highlight potential financing gaps, display inequities of aid distribution, and ensure that aid flows to those who need it most; leading to more efficient design and development of new projects/programs and increases in development impact.

7.1.2. Improving Donor Coordination

The evolution of international development includes increasing cooperation with other USG partners, international donor agencies, and international and national NGOs. USAID must understand each player's role to effectively program U.S. foreign development assistance. GIS maps can be developed to visually display where each agency is working and the projects they are currently or have previously implemented; helping shape a more effective and efficient development effort from all partners.

7.1.3. Effectively Telling the USAID/DRC Story

Openly and transparently communicating results to a variety of audiences is imperative to ensure that the American people and the international community become engaged in the Agency's work. A well designed MIS provides an invaluable tool not just for monitoring performance, but also for enabling the Mission to better articulate its accomplishments by providing a resource for organized and validated data to help the Mission tell its story in a cohesive manner. GIS tools provide a another tool to effectively communicating results to the public, Congress and other government agencies by creating easily understood visual representations of the data from an MIS. The depth and breadth of USAID programming can be easily presented on a map (paper or interactive interface) that clearly and concisely presents information on the where, why (i.e., needs of a country or region) and how USAID's work addresses these needs. The geospatial presentation of strategies and programs over time can also serve as a powerful tool in demonstrating how development is evolving.

7.1.4. Detailed MIS/GIS Benefits for USAID/DRC

A review of requirements identified through interviews with mission staff revealed a long list of specific uses and benefits that could be achieved with an MIS/GIS. The most immediate benefits are:

- Strategic planning through use of demographic and infrastructure layers.
- Evaluate funding proportionality between regions and sectors.
- Summary reporting and drill-down of data to detailed level for ad hoc analysis.
- View distribution of implementing partners in regions.

- Display the exact location of project activities and show the physical coverage of project activities.
- Provide a tool to collect, manage, and analyze performance related data to enable higher quality reporting as well as inform effective performance management of programs.
- Evaluate the project's significance in terms of other co-located or adjacent projects.
- Evaluate the project's effectiveness compared to previous projects in the same area or in areas with similar socio-economic or demographic variables.
- View relationships between project data and a variety of data sets including: socio-economic, demographic, education and health; land use, agriculture, soils, forestry, biodiversity, climate and availability of water; location of schools, markets, hospitals and other significant social constructs.
- Map and compare funding levels of programs and projects for portfolio reviews and on an annual or quarterly basis to help identify high, mid and low performing projects.
- Map and compare funding levels per capita, per target group or per unit cost in the country, region or project area.
- Map and compare funding levels in each sector, e.g., funding per capita/per school by region.
- Map change over time and assessing the direction of trends (demographic, funding, etc.).
- View statistical criteria in a spatial format to show the value of the funding and the progress of the project or national strategy.
- Visualize overlapping projects/programs within USAID, USG and other donors and determining areas of strategic fit.
- Understand the historical effects of USAID or other development projects.

This list should not be considered conclusive as more potential benefits will be discovered as different phases of the technologies are implemented.

7.2. Requirements Challenges and Drawbacks

While implementing MIS/GIS technologies has the potential to provide a large number of benefits for the mission, its implementation presents a number of challenges. From a data perspective, data collections must be modified to collect special related data. From an implementation perspective, GIS requires specialized technology skills and a level of organizational change. Experience from past GIS implementations at USAID missions and other organizations have shown the following challenges must be overcome for a successful implementation:

- Champion at the Mission Director level is key.

  - Director and other influencers must be committed to using the proposed MIS/GIS system as the official source for project and activity planning, management and evaluation information.
  - ADS notes that significant GIS failures due to low commitment from the top.
- Must support fundamental Mission efforts to track what is being done where (activities and locations).
  - There is currently no MIS – requires consolidation of implementing partner data in a single database.
- Generate maps and enable geographic analysis at various levels.
  - Functionality needs range from basic map displays to more complex geo-analytic functionality to enable program and activity planning.
  - Incorporation of newly available data sources as each new phase is implemented.
  - Basic mapping and geographic data analysis functionality in its initial release and with expansion for more sophisticated capabilities as each phase evolves.
- Missions must provide resources responsible for MIS/GIS data collection, update and data integrity.
  - Perhaps two dedicated MIS/GIS administrator roles at the Mission one supporting Mission and one supporting implementing partners
- Continual training including on-line “refreshers” –must be part of system design.
  - Accommodate staff and partner turnover as well as review of key concepts and operations.
- Partners play a critical role in the success of the MIS/GIS.
  - Engage partners in early MIS/GIS Mission tailoring activities.
  - Provide value-added functional benefit – such as reporting – to entering data into system to mitigate any potential additional LOE by partners.
  - Tie partner performance to timely and accurate data updates.
  - May need to renegotiate implementing partners contracts for new data collection procedures.
- Solution must provide the right balance of data capture and reporting.
  - Too much detail will be a “turn off” for users.
  - Too little detail will not provide value for management.
- Must be easy to use, with an intuitive and user-friendly interface.
  - Incorporate performance-centered design, where operation is intuitive.

- GIS can be expensive and require a lot of effort when starting from scratch.
- GIS operators and their managers must be trained to understand the capabilities of the technology. There is a large learning curved involved in implementing GIS technologies.
- Issues of standardization can also make it difficult to combine maps from other countries and/or organizations when trying to obtain a more regional or global view.
- Data collection from partners can be problematic. New data collection mechanism usually represents extra LOE for implementing partners. There's a large need to make data collection easy. Useful to engineer the data collection process provide additional value to implementing partners, essentially 'give something back,' for their effort.
- Relying on existing data sources can often be problematic as can collecting and integrating enormous amounts of data, sometimes from various sources.
- Integrating data from a variety of sources often requires extensive efforts to clean and convert the data into a useable format as well as perform spatial rectifications.
- Security requirement may be complex.
    - Features must consider local IT capability in DRC and diversity of users and locations in country.
    - Secure, 24-hour-supported server facility may not exist in DRC, may need to have hosting abroad.
    - Network connectivity and speed may be problematic in DRC.

7.3. Phased Approach to MIS/GIS

This recommendation of this assessment is to utilize a phased approach as the only practical method of achieving an MIS/GIS capability. There is no such thing as a best GIS the most useful system depends on the needs of the organization, the intended uses of the system, the data available, and the integration of the data sets and GIS technology within the organization. There does not exist any off-the-self solution that can instantly provide full MIS functionality with advanced GIS capability. As previously noted, several missions have attempted to build and implement their own MIS and GIS capabilities, with the MIS-based GIS system, a phased approach is essentially what is being used. A phased approach allows USAID/DRC to build toward the desired capability in a controlled manageable fashion and methodically add and integrate new modules and data sets that can be assembled into a full-scale MIS/GIS. Benefits can be achieved at each phase of implementation, which each new phase expanding on the capabilities made in the previous phase.

A central reason for utilizing a phased approach is that implementation of MIS/GIS will take a long time, and the time should be taken to ensure that it is implemented correctly. A phased approach allows the mission to build upon successes and ensure that each step is fully operational before expanding to the next step. In addition, since technology is changing rapidly, a phased approach allows for the re-

examination of technology and adjustments to strategy if warranted at any time. Not only are the mission's priorities likely to change as users work with this technology, but the nature of GIS and computing technology is continuing to evolve rapidly.

Figure 3 depicts the phases recommended by this assessment. The review and analysis of USAID and USAID-related MIS/GIS implementations is instructive toward a phased approach. As previously noted, all the advanced and MIS-based GIS implementations took a phased approach toward their implementations, which essentially allow the MIS/GIS to evolve. In the diagram, we have plotted the phase-status of some of the USAID-related MIS/GIS discussed in this document. Whether explicitly planned this way or not, all these initiatives evolve into a similar approach.

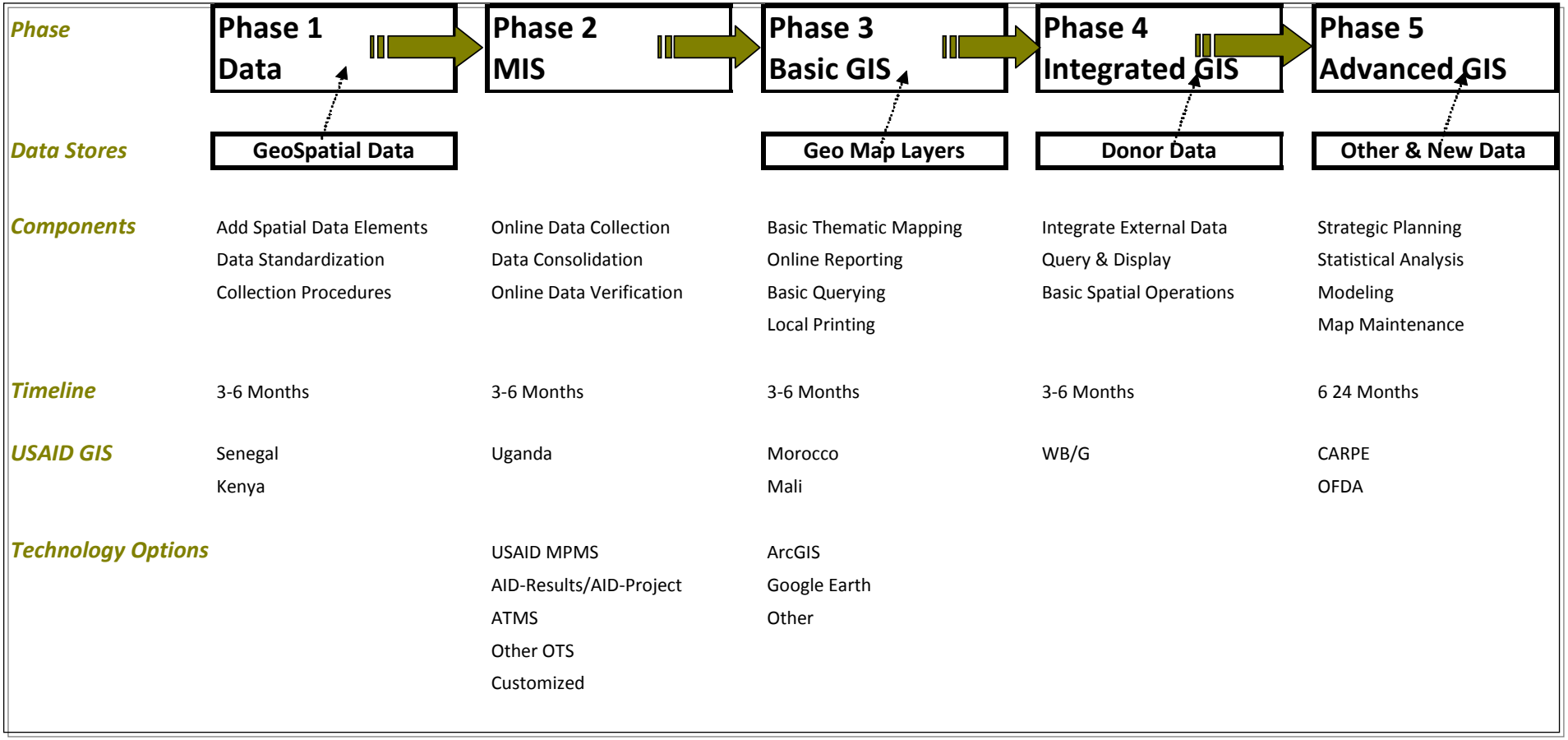


Figure 3. Recommended Phased Approach for MIS/GIS

7.3.1. Phase 1: Data Organization

The first phase of implementation revolves around creating a supporting data architecture and integrating geospatial coordinates with collected data which will eventually enable GIS capabilities. Development work, and the monitoring and evaluation of it, is also inherently spatial and most projects have activities that are implemented at a specific location and have far-reaching implications. The cumulative and cross-cutting effects of projects in the same or different sectors can be combined within a GIS to effectively communicate, monitor and evaluate program successes, failures and trends.

As noted in this report, there is no current central database in USAID/DRC that manages project data, nor are their standard procedures and data standards toward collecting this data. This phase is focused solely on preparation of the data architecture, which will be the foundation of the MIS/GIS and focuses on many aspects of data management needs to become more rigorous including:

- Standardizing the collection and management of baseline monitoring and evaluation data process.
- Creating data architecture (metadata) and data coding standards for the collection of data.
- Defining the levels of geospatial tracking elements and implementing them into the metadata and data collection procedures.
- Determine activity level variables to be collected such as date, location (town/village/etc.), performance indicators reported against for this activity, name of the implementer, and sector.

The result of the data preparation phase is thoughtful, well-organized data which makes it possible to query for required information. This phase is a prerequisite for the following phases no technology can effectively make up for disorganized and/or meaningless data.

It is also noted that an off-the-shelf system could make completion of this phase easier. Off-the-shelf solutions typically prescribe the data standards and processes on the organization in order for the solution to work, which normally limits the amount of work necessary to determine what the standards and process could be.

7.3.2. Phase 2: MIS

After the prerequisite data organization phase is complete, the mission can then look to implementing an automated system (MIS) that maintains project data and manages the data collection process. The foundation of all data collected is at the activity level and because of this, the bulk of project specific data collection is performed by implementing partners. Activity information is collected and reported back to USAID via various reports. The MIS will rely heavily on the implementers to input relevant activity level data into the MIS. To ensure the timely input of data, a standardized and user-friendly web-based data entry system is likely the desirable architecture. If necessary, data entry into this system could become a required quarterly deliverable (if needed contracts can be amended to direct contractors to submit this data).

There currently exists several off-the-shelf solutions available for this phases, both from contractors and from USAID (discussion of these options detailed later in this report). Again, it is noted that utilizing an off-the-shelf solution simplifies the work required for Phase 1 as an off-the-shelf solution would likely prescribe the decisions for process and standards.

7.3.3. Phase 3: GIS

In order to exploit data and to visually present this spatial information, a GIS is implemented in this phase. The GIS will visually present data queried from the MIS implemented in Phase 2, which in turn, is based off the standards and procedures develop in Phase 1. It is suggested that a web-based interactive application for public/private users be implemented to provide interested parties an interface with easy access to information – which is the case with most of the current USAID mission GIS applications reviewed in this assessment.

The specific functionality of the GIS will need to be determined and implemented at the start of this phase; however, some of the common capabilities pertaining to this phase discussed during this assessment are:

- Presentation of partner locations by partner type.
- Presentation of interventions by type.
- Presentation of specific interventions (i.e., grants pilot projects training).
- Presentation of success stories.
- Summary information (i.e., number of interventions by location by type).

It should be noted that for any of these, the user would be able to click or hover over an item on the map and retrieve more detailed data listings for each of the above. For example, the user could select partners, then see a point representation of each partner on the map, then click on a specific point to obtain a listing of partner description and contact information.

7.3.4. Phase 4: Other Data

After the first three phases described in this section have been successfully implemented, continued expansion of the system should be considered to incorporate new data sets. One of the common desires stated by all the technical teams is the desire to know what other donors are doing in the country to help coordinate activities for greater impact. This phase focuses on moving beyond the basic GIS maps and incorporating data sets from outside organizations, particularly other donors.

The technology challenges in this phase mostly revolve around the data itself. What standards for data collection to external data sets follow? Is the data complete? Is it correct? Is it meaningful when combined with Mission data? How will it integrate? How timely is the data? However, even more challenging in this phase is actually getting organizations to agree to share data. Now there is a user community that usually shares data, but it is not easy. There are communities of practice now that

are internationally organizing to share information and this will be key if this vision is to be fulfilled.

7.3.5. Phase 5: Advanced Applications

As the GIS analysts gain experience through the use of its desktop and web-based GIS tools, a list of potential enhancements should be developed. These are likely to fall into categories such as changes to web-based GIS applications, new desktop GIS utilities, new data layers, and updates to existing data layers. At this phase, GIS analysts begin to start exploiting capabilities in the GIS tool. In this phase, they begin creating and integrating new spatial layers into the display. They begin to create more queries into the tool. New applications are envisioned. More advanced queries and analysis are performed. Modeling projects can be undertaken. These projects and enhancements should be evaluated and prioritized.

7.4. USAID GeoCenter

Recognizing that GIS can offer tools to support an over-arching management information system for the agency, the Office of Science and Technology (PPL/ST) has established a Center for Geospatial Analysis for Development (GeoCenter) to improve the Agency's ability to use geospatial information technology for spatial analysis, strategic planning, monitoring and evaluation of projects, and communicating results. The GeoCenter serves as a focal point on matters concerning GIS and a coordinating role for Missions and Washington Operating Units, providing guidance and technical assistance to missions and bureaus, as well as geospatial analytical services. The GeoCenter provides a range of planning, policy, and learning activities by employing geospatial methods and technologies to help USAID think spatially about the programs it runs and to augment overall planning, monitoring, evaluation, and communication of development work:

Planning, Monitoring, Evaluation and Communication

- Geographic content management creates, collects, processes, and manages spatial layers.
- GIS data warehouse makes data available to internal and external audiences.
- Spatial analysis conducts spatial analysis and develops workflows, scripts and models.
- Cartographic products creates print and web maps.
- Web map applications develops custom web map services and web map applications.

Policy:

- Geocoding standards make USAID operational data and information geographic.

- Cartography standards develop custom branding and templates for USAID maps.
- Metadata standards make spatial layers searchable and sharable.
- Award contracts require partners to provide geocoded data and spatial layers.

Learning:

- Capacity building provides tools, training and support.
- Learning establishes partnerships coordinate activities across development community.
- Learning enables 'spatial thinking' across the Agency.

In terms of the phased approach recommended by this assessment, the GeoCenter can be envisioned in being involved mostly through Phases 4 and 5. Their focus is on providing guidance and support on advancing the GIS function. It is envisioned that the GeoCenter will be a central repository for digital maps and other GIS resources. It is envisioned that they would eventually develop a mission GIS tool kit, containing common denominator types of tools that could be useful for all missions including DRC.

It is noted that this assessment was performed in a coordinated fashion with the GeoCenter to ensure that the methodology employed fit the GeoCenter vision. The recommendations provided in this assessment were shared with GeoCenter staff and there was consensus that the phased approach present was appropriate.

It is also noted, at this time GeoCenter staff is recommending the implementation of the USAID MPMS as the MIS and ESRI as the GIS component for all missions looking for MIS/GIS – which this assessment is recommending for USAID/DRC, as described later in this report.

(Information provided from Interview with USAID GeoCenter Staff and supplied documentation)

7.5. MIS Recommendation

For many years, USAID Missions have recognized the key role of MIS in support of the planning and reporting required by the projects and activities they manage in support of the Agency's goals. A key aspect of Missions' MIS requests is the ability to link project and activity results to investments, and to present data using geographic mapping tools.

Data quality is the key success criteria to any MIS or GIS. It is not possible to perform sound information analysis if quality data is unavailable. Collecting and maintaining good data is no easy process. Analysis of the key USAID/DRC project and activity management business processes and reporting highlights the need for a comprehensive, data-centric solution to streamline and simplify the management information efforts currently in place. Key to such a solution is standardization of business processes that facilitate project and activity management and reporting, while at the same time accommodating the individual data and process needs of local stakeholders in the form of custom reports and remote partner access.

In addition to paving the way for a quality GIS, an MIS on its own presents a significant opportunity for reducing duplication of effort and increasing the usefulness of Mission information management resources:

- Reduction in the level of effort expended by Mission staff and partners to execute updates of project and activity data and information and to generate queries and produce reports.
- Dramatically reduce any redundant effort associated with data entry by linking data stores from the appropriate automated systems as appropriate.
- Enable just-in-time data queries and reports to accommodate a variety of sorting, content, and formatting requirements, including scorecards and dashboards.
- Project and activity content will be strengthened through more timely updates and will demonstrate a stronger link of results to investment.

Figure 4 provides a high-level data flow schema of how MIS enables the entire MIS/GIS architecture. The MIS collects project and activity level data. Data is entered by implementers and USAID staff on a simple, intuitive interface that will then feed into the MIS. MIS is queried to provide a wide variety of maps, reports, and analyses used for M&E, project/program planning, and reporting. A web-based GIS is implemented on top of the MIS that can clearly communicate the "who, what, when, where, and how much" to implementers, beneficiaries, USAID/W, and the public. The MIS is the cornerstone in the architecture for an MIS/GIS that enables the connection of a project and activity portfolio reporting at the Mission level with GIS technology and other data sources.

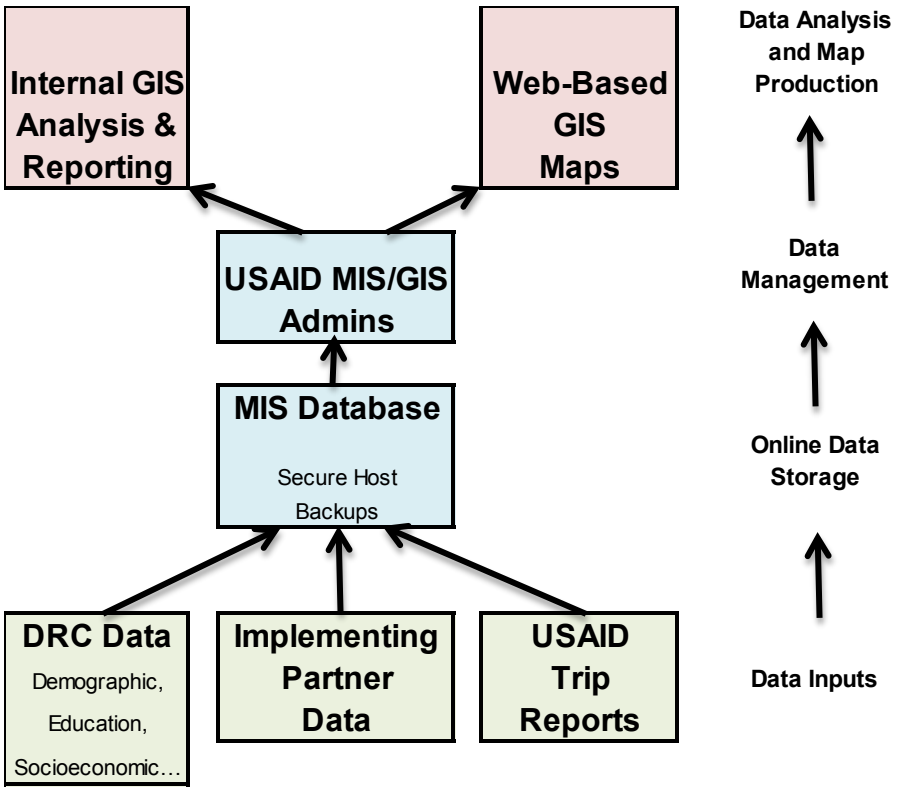


Figure 4. Data Flow Schema with MIS as the backbone of MIS/GIS

7.5.1. MIS Options: Custom vs. Off-The-Shelf/Software-as-a-Service

In the absence of a coordinated effort to develop an MIS solution, several individual missions have made substantial investments to develop isolated technology systems with mixed results. Other missions have contracted with vendors to install canned software or provide a web-based service for an MIS solution.

When a software solution is required, there are two choices: custom or software-as-a-service (OTS/SaaS). For this section, custom software is defined as computer software that the mission would have to contract to an outside software development company to develop specifically for USAID/DRC. There have been a number of USAID missions that have gone this route for their MIS/GIS. OTS/SaaS software is usually purchased/leased from a vendor who has developed the software and/or hosts and maintains the application for the customer's usage for an ongoing fee. It's not always easy to decide between custom or OTS/SaaS software since it often requires long hours of deliberation and an understanding of the pros and cons of each choice. Tables 1 and 2 provide a summary of the considerations considered toward the recommendation of which type of MIS solution is best.

Custom Software PROs:	*Custom Software CONs:*
• Written to Mission's exact business rules. • For OTS, Mission owns the source code giving control over future enhancements. • No major license fees. • In-house Help Desk personnel more familiar with the business rules involved. • More useful and meaningful reports than what vendor supplies. • Vested users readily accept the software.	• Likely more expensive than 'canned' software. • Not immediately available. • May be re-inventing the wheel.

Table 1 Summary Pros/Cons of Custom MIS Solution

OTS/SaaS PROs:	*OTS/SaaS CONs:*
• Immediately available. • Initial cost almost certainly less than custom. • Don't have to re-invent the wheel. • Technical support OTS vendors know their package. • For SaaS: Less risk only pay as long as you use and turn off any time.	• Less extensibility. Usually "work- • Ongoing SaaS/maintenance fees. • At the mercy of the vendors. • Non-vested users can become frustrated by "learning curve."

Table 2 Summary Pros/Cons of OTS/SaaS MIS Solution

The general rule for deciding between the two is, if you find a COTS package that meets your requirements and is reasonably priced, then go with it. However, if you need a solution that more closely meets your specific requirements and is flexible enough to change as your business changes, then you should consider a custom software solution.

As previously mentioned, USAID/DRC is not the first USAID mission to consider implementing an MIS/GIS, and there are a number of OTS/SaaS options available to consider. There is no evidence that USAID/DRC processes differ greatly from other missions and probably would not benefit from the extra expense and risk of developing a custom solution. Therefore, this assessment highly recommends that USAID/DRC implement an OTS/SaaS solution.

A discussion of the recommended MIS OTS/SaaS options available follows.

7.5.2. OTS/SaaS options

There are a number of OTS/SaaS options that USAID/DRC should consider. As previously mentioned, a number of missions have already contracted vendors to provide MIS solutions and add proof to their viability. This section explores several options and provides a recommendation to implement the solution that is being developed by USAID M/CIO/KM.

7.5.2.1. USAID Mission Portfolio Management System (MPMS)

USAID M/CIO/KM commenced an effort in the fall of 2010 to analyze the current business processes of several representative missions as related to project planning, monitoring, evaluation and reporting. This analysis resulted in the definition of modules and requirements for a technology solution that can fulfill the baseline needs of all missions in support of project and activity efforts, and is flexible to accommodate the unique data and business process needs of an individual mission.

The team has concluded that a coordinated effort should commence to develop a comprehensive Mission Portfolio Management System (MPMS) for USAID's missions. The proposed MPMS would be designed as a flexible, module-based technology solution that allows missions to pick and choose the modules they need for their operation. Using the analogy of a "Lego kit," the proposed MPMS would give the missions the "building blocks" for constructing an effective technology solution to enable project and activity planning, management and reporting. The system would allow the missions to use only the modules they need and enable customization and tailoring via a flexible, table-driven architecture that would support reference table population with user-defined values and descriptors.

The key findings of this assessment are summarized in Appendix A.

This analysis resulted in the definition of modules and requirements for a technology solution that can fulfill the baseline needs of all missions in support of project and activity efforts, and is flexible to accommodate the unique data and business process needs of an individual mission.

Based on the information gathered in mission visits, continued dialogue with mission management, staff and partners, the key findings (Appendix A) and continued analysis of design and architectural options, the team has completed a business case for the development of a pilot implementation of the MPMS. The business case has been submitted to the Chief Information Officer's management team with the following recommendations:

- Management should approve funding for the development of a pilot MPMS to support USAID Missions in their expressed need for an automated solution to enable more efficient and effective project management processes.
- The pilot MPMS design will be completed in cooperation with at least two (2) missions who have pledged their commitment to work on the proposed MPMS and to support its implementation.
- The design of the pilot MPMS will include linkage to critical USAID systems, such as FACTS or its replacement FACTS Info, to avoid the need for data re-entry and to support the elimination of "stove-pipe" IT solutions.
- The pilot MPMS architecture should consider a cloud-based, COTS platform, which will help address time-to-market and risk management issues that are often associated with global technology solutions.
- Unless the more coordinated effort is undertaken to develop a comprehensive MPMS to meet mission needs, the "one off" systems will continue to proliferate, learning will exist in isolation, and funds will be spent in an inefficient manner.

Figure 5 provides view of the proposed layers of functionality for the MPMS for missions, representing the most common business processes to enable project and activity planning, management and evaluation.

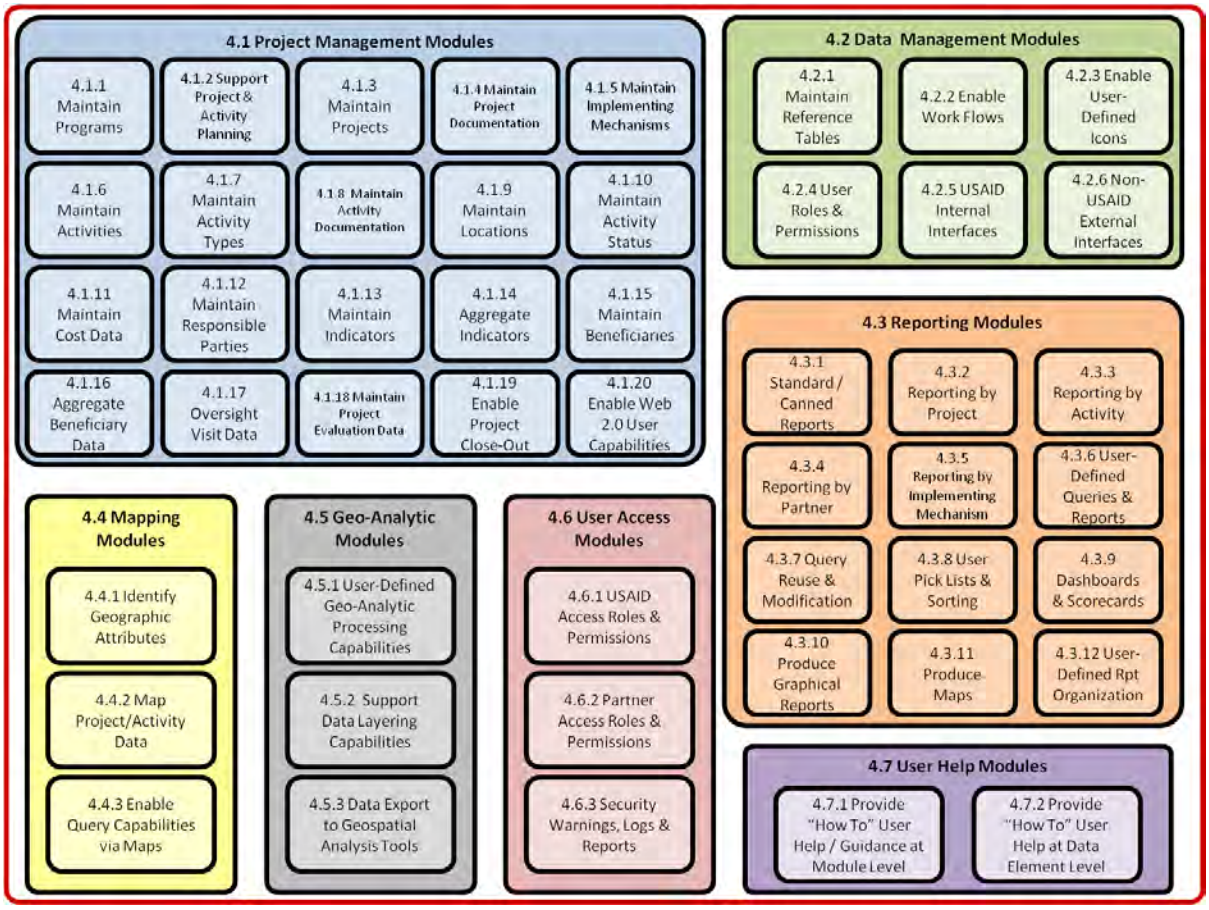


Figure 5 MPMS Proposed Functionality

At this time, MPMS is in development phase with two pilot implementations – Dominican Republic and Senegal – planned for later this year. There are currently six to eight missions in line to have MPMS implemented following the pilot phases. The development team appears to be undertaking a slow but methodically complete pilot/implementation process to ensure a successful roll-out.

The knowledge management team presented a demo for this assessment to review against the requirements gathered to date. Though some functionality was not able to be demonstrated – such as partner dashboards – the functionality has been developed at the time appeared to satisfy basic mission requirements. While the system appears to be on track for a successful development, it is not possible to determine its full acceptability until it reaches pilot phase.

Given that USAID has decided to invest in creating a system to service its missions worldwide, this assessment highly recommends that USAID/DRC start planning on utilizing the forthcoming MPMS. The benefits to MPMS is that it is anticipated that since requirements are driven by missions and USAID is supporting the worldwide effort, that USAID/DRC would receive best-fit and better support than other options. It is a cloud-based solution and does not require any investment in hardware/software by USAID/DRC. As the user base grows for MPMS with more missions signing on, the system would be easier to change with changing mission requirements. In addition, guidance from the GeoCenter indicated that they were recommending that mission implement MPMS as a basis for their GIS it is likely that the GeoCenter will develop future tools based on this model.

This recommendation assumes that USAID will continue with its commitment to ensure the success of the MPMS and that the pilot implementations result in success. It is also noted that it may take a while for this option to be available to USAID/DRC. Therefore, it is recommended that a steering committee be formed and establish communication with M/CIO/KM in order to schedule and start planning for a future implementation.

Additionally, at this time the cost structure for using MPMS is unknown. This assessment will assume that there will be a cost-sharing model charged to missions to pay for usage of the cloud-based system. The assumption is that part of the reason for developing the solution is for cost savings to the missions and the resulting costs would be reasonable, or somewhat in line with other SaaS options.

(Information provided from USAIDM/CIO/KM staff and documentation)

7.5.2.2. Interim/Alternate MIS Solutions

As previously noted, while this assessment recommends that USAID/DRC pursue an implementation of upcoming USAID's MPMS, it is not immediately available and it is not known when it would be available. With the pilot roll-outs upcoming and six to eight missions already in line, it appears the earliest possible implementation for USAID/DRC would be late 2012 – an optimistic guess. USAID may want to consider interim MIS solutions to bridge the time gap and start consolidating data. The reasons for going this route may go beyond just timeliness of MPMS availability there is always a risk that MPMS does not become a viable solution – this report is not assessing the likelihood of an MPMS failure, only noting that it is possible for any

number of reasons. With the implementation of MPMS likely well into the future, an MPMS failure would result in lost time and opportunity in the interim period. Therefore, interim and alternate solutions should be explored.

As this assessment recommends an OTS/SaaS MIS solution, the recommendation applies for possible interim solutions as well. In particular, an SaaS solution can be turned off easily when needed and only requires costs for the duration of time that the solution is used. As previously discussed, other missions have implemented proven MIS solutions that could easily be configured and reused for USAID/DRC and the likely options are presented below.

7.5.2.3. AID Development Suite Interim SaaS Solution

The AID Development Suite is a suite of open source information systems designed specifically for agency development projects. AID Development Suite is comprised of three application modules that support project management; monitoring and evaluation, training, and secure web-based data collection and reporting. All three applications are tools designed and developed specifically for USAID international development projects.

AID-Project, originally created for USAID/Jordan's AMIR program, has evolved to include a complete feature set essential in managing many different types of USAID activities. AID-Project has been used in implementing a comprehensive economic development project in Jordan, a financial services project in Cairo, multiple projects in Asia and the Caribbean, and is currently being used in a national health project in the West Bank, economic development projects in Egypt, Georgia and Pakistan. AID-Project gives management personnel including contractor field and home office staffs, USAID Mission partners, and subcontractor/consultants access to essential project management information: planning and budgeting data, online approvals, document-management, results reporting, and more. Recently the system was enhanced to include geo-mapping of interventions and success stories. AID-Project streamlines communication and has served as a critical success factor in achieving transparent, sustainable project outcomes.

AID-Results – previously called Partner Reporting System (PRS) – developed for the USAID/Pakistan FIRMS project and in use in the USAID/Georgia Economic Prosperity Initiative project, provides a way for USAID projects to manage results and indicators both at the mission level and at the level of the mission's projects, and to integrate that tracking into project management systems like AID-Project. AID-Results is an online application designed to permit the mission and its contractors to define and describe the mission's results framework and corresponding performance indicators based on and compatible with the Agency's current PMP processes – it can produce the performance indicator reference sheets, reporting/mapping input, etc. The system allows users to define and describe indicators by data type, unit of measure, disaggregation parameters, data acquisition frequency, data source, and data entry responsibility. Indicator definitions include descriptions of data quality issues, estimated collection costs, and plans for indicator analysis, review and reporting. AID-Results manages the collection of the aggregated and disaggregated performance data including the ability to disaggregate results data by geo-location

and provides a flexible reporting framework that can be expanded to provide performance reports tailored to the specific Mission and USAID.

The third component of the AID Development Suite is AID-KM (previously called "EZRO"), a web-based knowledge management portal established to provide a robust content management system with easy-to-use dynamic content generation integrating data from AID-Project and AID-Results. The portal can enable projects to set up a site with interesting news stories, videos and resources quickly and easily. Devis has created over 40 unique instances of AID-KM content management solutions to support federal agencies in their quest to connect with their target audiences. Several of these sites have won awards based on their ability to deliver high value to citizens in a knowledge management and eLearning solution.

AID-Results is a full featured, low cost, low risk solution provided as software-as-a-service with minimal setup time, training, and monthly support overhead.

7.5.2.4. Activity Tracking and Mapping System Interim SaaS Solution

As previously noted USAID/Morocco has been building its geospatial capabilities to better collect data, and design and monitor its development projects. The mission's long-term goal of building a GIS resulted in the launch of the Activity Tracking and Mapping System (ATMS). ATMS is a web-based MIS/GIS that allows beneficiaries and implementing partners to access USAID project data and communicate development results to the public and USAID/W. The system provides capabilities to analyze and manage mission data, generate maps and other analyses that assist with monitoring and evaluation, assist in data-drive project design, and effectively communicate development results, outcomes, and impact.

ATMS has been developed so that it is flexible to be utilized by other missions. A review of the functionality provided by ATMS would meet the requirements for MIS for USAID/DRC with little modification.

The system is currently hosted by a vendor located in Morocco and though the software was originally custom development funded by USAID/Morocco, it is essentially being provided to the mission as a service.

A review of the functionality provided by ATMS has determined that ATMS could service as an appropriate MIS for the USAID/DRC. It currently integrates with ESRI GIS software to form the GIS component of the MIS/GIS.

This assessment also recommends ATMS as an interim MIS solution. There are several possibilities for implementation of ATMS for USAID/DRC, however, the most efficient would be for the ATMS vendor to simply install a new instance of ATMS on its existing servers. An SaaS agreement would have to be negotiated with the ATMS vendor if this option is chosen; however, it would not be expected to be cost prohibitive – the initial cost to develop ATMS was only $60,000. The software could be hosted and managed by other vendors just as easily, but sticking with the vendor supporting Morocco invites less risk. As discussed in other areas of this report, it is unlikely that there would be sufficient resources in DRC to host a system locally.

7.6. GIS Recommendation

The main value proposition of GIS is as a communications tool. Present realities necessitate that the mission be able to report its activities to the world, other donors and Washington. A GIS-generated map can display different USAID activities and their funding levels over a geographic area so that leadership and the public can quickly grasp where and how the agency is spending its money.

GIS also has important uses as a management tool within the agency. It reveals new relationships and trends, illustrates evidence-based rationale, and allows for sophisticated and robust spatial analyses. GIS technology coupled to the missions MIS can be used to track ongoing activities, generate summary reports, measure output results and strategically plan where to place new projects. An example: GIS technology could be used to guide the placement of new village health care centers based on population density levels.

As previous detailed in this assessment, the MIS component recommendations are cloud-based solutions, which provides the database back-end utilized as the primary repository for GIS functions. In addition, most of the MIS solutions provide elementary GIS capabilities built into their interfaces, providing pre-defined queries and drill-down addressing common questions. However, it is noted that these built-in capabilities will always be limited, and as the implementation moves toward Phase 4 and Phase 5, additional GIS software will need to be employed to achieve greater capabilities.

7.6.1. GIS Resource Options

When developing a conceptual system design, it is helpful to consider the primary components that comprise a GIS. This section contains an overview of options available for each of these components.

7.6.1.1. Hardware Recommendation

Many options exist for the hardware component of a GIS in terms of the computing platform, peripheral devices, operating system, and network environment. GIS software is available to run on any of the standard computing platforms (e.g., desktop PCs, servers, laptops, PDAs, field-based computers, etc.); operating systems (e.g., different versions of Microsoft Windows, Linux, Unix, etc.); and networks (e.g., Windows-based, Novell, etc.). It is recommended that USAID/DRC pursue a system designed to be fully compatible with the existing USAID standard computer resources.

7.6.1.2. Software Recommendation

Several companies provide GIS software products appropriate for government and NGO applications. Market leaders include ESRI, PB MapInfo Corporation, Intergraph, and Autodesk. After implementation of Phase 3 MIS/GIS, a decision must be made regarding which GIS product line should be used as the basis for the conceptual GIS design. In the development of the GIS design, the following criteria were taken into consideration:

Product Line This refers to the type and extent of software products available from each vendor, and how well these meet USAID/DRC requirements.

Costs This refers to the initial purchase prices and any ongoing costs such as software upgrades and maintenance.

Market Share The extent to which the GIS software manufacturer's products are used. Market share is an indicator of a product's success in satisfying user requirements. A large market share is also an indicator of product longevity and manufacturer support.

Support Services The availability of support services related to the use and maintenance of the product. Typical support services include: technical support, training, upgrades, custom application development, and established user forums.

Data Compatibility The compatibility of the spatial data format(s) of the selected software with that used by other organizations. The important consideration is that data sharing and exchange are possible.

There are a number of GIS software companies. The most well known in the commercial world is ESRI. They have produced a number of software programs ranging from ArcView to today's latest and greatest package, ArcGIS. There is another software company called Intergraph, and they produce Geomedia. Geomedia and ArcGIS are very similar in their functionality. They are competitors in the market place and they both can do the same thing. There is another developer called MapInfo. The prices range depending on the functionality from around $500 to $2,500.

It is recommended that USAID/DRC use ESRI software products. Primary considerations for this recommendation are the implicit endorsement and possible enterprise licensing of the USAID GeoCenter and CIO/KM group, the use of ESRI products within other USAID missions, and the benefits offered by ESRI technology. Other factors that contributed to this selection include:

- ESRI is the clear market leader of GIS technology.
- ESRI provides a broad range of products capable of meeting the mission's current and anticipated needs.
- The use of ESRI software provides consistency with other missions, donor organizations and USAID groups.
- Many commonly available GIS data sets are provided in ESRI software formats.
- Technical support services are available from a large number of companies.

The ESRI software products contain a suite that provides a wide range of GIS capabilities ranging from basic web-based mapping to complex and powerful desktop-based analysis. The exact components of the ESRI suite that will be needed will change as the implementation of GIS evolves. At this time it is impossible to predict with any certainty which products would be required as the exact requirements can not be fleshed out until after MIS has been implemented. Appendix

C provides a detailed discussion of the ESRI modules that are available and when they would be applicable.

7.7. Data Standards

As detailed in this report, USAID's Office of Science and Technology (PPL/ST) has established a Center for Geospatial Analysis for Development (GeoCenter) to serve as a focal point on matters concerning GIS. The GeoCenter serves a coordinating role for providing geospatial services and technical assistance as well as a broad range of planning and policy activities. Among these policy activities is the responsibility for determining GIS Standards for geocoding of USAID operational data, cartography for USAID map templates, and metadata that allows layers to be searchable and sharable. It is understood that the GeoCenter is developing specifications that take into consideration of industry-wide standardization efforts conducted by organizations such as AidData and the International Aid Transparency Initiative (IATI). Additionally, these standards are being designed to comply with USG regulations, including Federal Geographic Data Committee and ISO content standards for digital geospatial metadata and draws upon previously conducted assessments of data holdings and standards.

The GeoCenter is currently in the process of developing the standards for each of the areas identified above. While progress on standards is being made daily, in order to provide a general idea of current status, a recent standard working group status is provided below:

- The group is trying to get standards for the metadata that we are going to be collecting.
- The GeoCenter will be a repository for all geospatial layers that USAID will have access to.
- The group desires to keep track of the metadata and to know the title, theme, and standards of data long after people in group are gone. Gathering ideas for how to go about this.
- Establishing a standard guideline for baseline metadata with yearly updates. Expectations are that standards will evolve.
- Work is underway on how the standards would be rolled out.
- All work will be done in an XML file.

More recently, the working group has been working on data standards in relation to the USAID MPMS system that is currently being developed – which is the recommendation of the GeoCenter and this assessment for Phases 1-3). A summary of the current draft findings related to MPMS follows. It is noted that these draft finding are likely to change as they evolve:

Geocoding Standards

Missions starting with MPMS and coding future interventions, the following will be done:

- Activities are the unit of mapping – even efforts that have only project-level data must register activities in order to be mapped. Portfolio data at the most detailed level provides more options for data use and analysis.
- Activity locations will be recorded as they are brought online either by: 1) decimal degree coordinates (longitude/latitude) derived from GPS or digital map interface, or 2) a town/village/place name geocoded by internal service of MPMS (also resulting in longitude/latitude).
- It is expected that partners will provide required level of detail for activities. There will be a field for a code indicating both the precision and extent of the activity at the marked point.
- Activities that have a national scope or cannot be mapped to a specific location will be accounted for on a separate webpage that opens from a link tied to an icon at the national capital.

Visualization Standards

Geocoding standards have a direct effect on how activities can be visualized and likewise the way one wants to visualize portfolio data affects the standards. Because activities will be coded at the detailed (village) level, that is the most refined level that can be displayed. In the other direction (less detail/refinement), the data can be aggregated at various roll-up levels. Some possible common aggregations:

- All activities at the same coordinate.
- All activities with the same implementer.
- All activities within the same sector within an administrative unit.
- All activities within the same component within an administrative unit.
- All activities within (any category) within an administrative unit.

This is a large task involving several working groups and this assessment and as such, this assessment notes that the defined standards from this endeavor will be forthcoming and recommends that DRC does not deviate from the prescribed forthcoming standards. Deviations from data standards will likely result in the deterioration in the ability to share and query the data as well as have potential adverse effects on data quality.

7.8. Data and Layers

A number of options should be considered regarding the data component of a GIS. Options range from the selection of data layers to be included, to how these data are stored, accessed, managed, and maintained. Options and issues to be resolved include:

- **Application Requirements** What data layers are needed to support the Mission's programs, and how are these prioritized based on importance?
- **Use of Existing Data** What data layers already exist that can be used?

- **Development of New Data** What data layers do not currently exist and therefore must be developed to support priorities? What is the level of effort needed to create and maintain these new data layers?
- **Format** Commercial GIS Software packages use different physical formats for storing data layers. For some products, more than one data storage format can be used (e.g., shapefiles or geodatabases in ArcView).
- **Storage** GIS data layers can be stored as individual computer files or in relational database management systems.
- **Access** Different levels of access to GIS data layers can be put in place. These range from: read-only access where the user has no ability to edit the data; to read-write access where the user can edit selected data layers; to administrative access allowing for file management activities such as renaming, moving, deleting, backup, and archiving.

7.9. Resource Requirements

As a precursor to MIS/GIS, it is important to have an understanding of the physical and human IT situation at the Mission and in DRC. This would include: human IT resources; communication networks; security; database backup processes; space and cooling; electrical supply and backup; and other physical factors that could affect the IS. After a cursory on-site assessment of the IT situation in DRC, this report will assume that the local environment lacks adequate or stable resources and capabilities to securely host a web-based MIS/GIS at a reasonable level of reliability or security. Interviews with several local DRC IT experts confirmed this assumption. Therefore, this assessment assumes the eventual web-based modules of an MIS/GIS solution either be cloud-based or a remotely hosted solution.

7.9.1. Personnel Requirements

Personnel issues are often overlooked when designing an MIS/GIS. However, a system cannot be successfully implemented without addressing this basic component. The following is a list of the functional roles that are needed to fully support the recommended MIS/GIS implementation.

While these roles are meant to identify areas of responsibility that must be accounted for, they do not correspond to the number of staff needed. It is common for individuals to be assigned responsibility for more than one of these functional roles. It is possible that current mission technical team members can serve both their project role as well as a GIS-specialized role. Also, certain specialized or labor-intensive tasks are contracted out to qualified consultants.

Phases 2 and 3 The implementation of MIS in Phases 2 and 3 will require the role of a system administrator responsible for the ensuring that the system is in operation and used properly.

MIS/GIS system administration duties:

- Setup security policies for users.

- User administration (setup and maintaining accounts).
- Configuration and maintenance of reference data.
- Verify data quality.
- User support.
- Monitor system performance.
- Create backup and recovery policies.
- Implement the policies for the use of the system.

Phases 3 and 4 The implementation of the GIS component will require the need for GIS analysts responsible for administering and developing GIS capabilities in the system. We are assuming there are two roles, the GIS coordinator role being more supervisory and a coordinating role of the two. There will likely be overlap in responsibilities of these two roles and overlapping with the system administrator. It may be useful for one analyst to focus on partner data and usage of the system and the other to focus on mission staff. GIS coordinator duties:

- Coordination and communication of GIS opportunities, issues and needs of management and staff.
- Administration of an accurate, up-to-date GIS database (data maintenance, procurement, etc.)
- Application maintenance to assure seamless performance and integration of the GIS and other interfaces.
- Administration of an ongoing training program.
- Administration and data procurement/development for ongoing and special GIS projects.
- Management of additional GIS staff, and coordination with GIS users.

GIS analyst duties:

- Maintaining map layers and supporting attribute data.
- Creating custom maps and reports as directed by the GIS coordinator.
- Coordinate activities and provide support.

Phase 5 Advanced capabilities required in Phase 5 will require at least a GIS system developer in order to develop and implement programming and applications to improve productivity associated with GIS, infrastructure records, or spatial data applications. These are highly skilled GIS technicians that develop advanced GIS modules, create visual layers, and generally exploit the capabilities of the GIS. This role would like be served by a contractor as the need for this resource is usually on a case-by-case basis. It is possible that current mission technical team members can serve both their project role as well as a GIS-specialized role.

GIS developer duties:

- Determine needs, develop concepts, and prepare feasibility/cost studies for new projects.
- Design, develop, implement and maintain customized systems and applications.
- Develop and maintain work instructions, procedures, policies and other documentation necessary for the effective utilization and maintenance of implemented applications.

7.9.1.1. Training Requirements

It is recommended that all relevant mission staff be trained on the basic concepts and use of relevant GIS software. The level of training is dependent upon the category of user as described below.

Incidental users Incidental users are infrequent users of the GIS. They are usually not familiar with GIS but have a need to get specific information or maps. Examples of these users would be government users and most mission staff. They will usually access the system through an Internet browser or through requests to the GIS coordinator. This category of user will need no technical GIS training. The recommendation is that the GIS coordinator hold a series of "brown bag" lunches for this group that will demonstrate the capabilities and uses of GIS.

Casual Users Casual users are staff who use the GIS on a regular, but limited, basis to perform repetitive queries. Training for this group is focused around using specific applications that have been created for their use. The applications provide a quick point-and-click environment that produces the desired results in a minimal amount of time. This category of user should receive application specific training. They should be formally introduced and trained on the applications relevant to their business process as they are developed and deployed. This training should be carried out with a combination of vendor-based training and periodic updates by the GIS coordinator.

Advanced Users Advanced users are staff who routinely perform non-standard and detailed analysis tasks. This smallest group of users requires the largest amount of GIS training. They will typically perform these tasks for the incidental and casual users on an as needed basis. In addition to the training for casual users they will need to have formal ArcGIS training performed by ESRI-certified training facilities. This category of user should receive formal technical training at ESRI-certified training centers. It is recommended that at least the GIS coordinator (and/or GIS analyst) should have formal GIS software training and significant user experience.

7.9.2. MIS Resource Requirements

As previously covered in this assessment, all recommended options for the MIS module are cloud-based software-as-a-service solutions. Implementation of any of the mentioned solutions would require no additional investment in hardware or

software resources, nor ongoing maintenance costs from the mission. All resource expenses are included in the periodic costs of the service supplier.

The mission will, however, need to provide staff support and implement organizational change management to ensure the MIS is functional. The largest level of effort related to MIS is the involvement of the implementing partners who will need to be trained to provide timely updates to their project and activity data. This will likely require some contract renegotiation with partners, as changing their reporting process is likely to require a modification in their level of effort for reporting. During this assessment, there were anecdotal stories of similar instances at other missions, where partners will complain but ultimately agree that web-based MIS reporting provides them benefits and is a superior mechanism.

From the mission's organizational standpoint, COTRs will need to be actively involved in verifying and coordinating the acceptance of project and activity data. This will require changes to the various activity reporting processes that COTRs are currently using.

As previously noted, support of the MIS will require, at a minimum, a system administrator. This role is to administer system set up, user configuration, data maintenance and debugging, and provide general support to users. This may or may not be a full-time position and could potentially be a current staff person that has other project responsibilities. Coordination of training and system start-up could also be performed by the MIS vendor or by an internal system coordinator.

7.9.3. Budget Estimates

The MIS/GIS system design and implementation plan developed for USAID/DRC contains realistic, attainable goals. The proposed phased implementation plan does not require investments for computer resources for the MIS component, but rather, involve periodic charges for software services to achieve the MIS function. The advanced GIS phases of implementation (Phases 4 and 5) may require some investment in hardware, software, application development, and training. However, it is anticipated that the timing of the GIS component is far enough in the future that the technology may advance to the point that the functionality for advanced GIS may be available as a service, eliminating the need for up-front investment in hardware and software.

The figures in this section are estimated expenditures associated with these items at current rates and technology capabilities, and do not include costs associated with existing GIS resources (e.g., annual maintenance for GIS software, staff salaries, etc.) This information is intended to support the budget planning process by providing the mission with a general sense of the costs associated with the implementation and expansion of both an MIS and GIS. However, it is very likely that technological improvements could easily change the items and costs presented here.

Year 1 Costs MIS/GIS

During the first year, the USAID/DRC will focus on implementation of MIS capabilities. Several recommendations were presented in this assessment. Unfortunately, the primary recommendation of implementing MPMS has a number of

unknowns. Since the project is currently in the pilot phase, it is unknown when it will be available for USAID/DRC. In addition, CIO/KM has not determined a cost-sharing for missions; therefore, it is impossible to speculate on what the costs will be. This assessment will assume that USAID is developing MPMS to provide a cost-effective service for its client-missions and that the price would be low, or at least in line with other commercial options.

Since all the recommended solutions are software-as-a-service solution, there is no need for investment in hardware or software licensing. Costs are limited to up-from implementation and ongoing servicing costs.

The tables below provide estimated pricing for each recommended product and related services. It's very important to note that there has been no cost-sharing decisions made for MPMS or contract negotiations for ATMS; the numbers provided here can be considered to be wild guesses at best. The actual costs may be much higher or lower.

Recommended MIS USAID MPMS

Product		
USAID MPMS	SaaS	$100 $5,000 per month (may depend on number of users)?
	Setup	$0 $10,000?
	Training	$0 $10,000?
	Help Desk Support	$0 500 per month?

Option: Interim MIS AID Development Suite and AID-Results

Product		
AID Development Suite	SaaS	$1,125 per month
	Setup	$3,750
	Training	$8,500
	Help Desk Support (optional)	$300 per month
AID-Results only	SaaS	$200 per month
	Setup	$1,500
	Training	$3,000
	Help Desk Support	Included in the SaaS monthly fee

Option: Interim MIS Activity Tracking and Mapping System

Product		
USAID MPMS	SaaS	$100 $500 /month?
	Setup	$0 $5,000?
	Training	$0 $5,000?
	Help Desk Support	$0 100 per month?

Costs Year 2 GIS

In Year 2, USAID will incur a number of one-time costs associated with the initial setup and implementation of the GIS system. These costs will be primarily related to the purchase of software and technical services.

ESRI Software Licensing	$2,500 $10,000
GIS Web Server	$5,000
Setup and Configure the Web Server	$1,000 $2,000
End User Training for Web-based GIS Applications	$1,000 $2,000
ArcGIS Server System Administrator Training	$1,000 $2,000
Develop Custom Web-based GIS Applications	$25,000 $35,000

Costs for Years 3-5

After GIS implementation, USAID/DRC will have completed the "one-time" purchases associated with the various tasks in Phase 2 of the implementation plan (as described in the previous table). From this point forward, the costs of the GIS will be related to ongoing operations and system expansion or modification. In addition to the annual maintenance fee charged for ESRI's GIS software, the mission may want to budget for the following annual expenses, some of which may or may not be performed by existing staff:

GIS technical support services professional services to use primarily for the web-based GIS applications.	$2,000 4,000
Training to send 1 to 2 staff members to a technical training course on GIS.	$4,000 $8,000
Application development professional services to enhance the existing web applications and/or developed desktop tools/utilities or applications.	$5,000 $20,000

8. Summary and Next Steps

This assessment created enthusiasm among mission staff and a strong willingness to invest in a thorough needs assessment and conceptual design for a Mission-level MIS/GIS for USAID/DRC. This assessment found that USAID missions have similar information and data collection problems and have identified opportunities by implementing new and evolving MIS and GIS technologies. The five phases outlined in this report provide a sound, sequential methodology for making significant enhancements to the Mission's current data collection and reporting processes and evolving into a robust GIS-capable platform. In addition, the plan provides flexibility for changing direction as technology evolves while still gaining value from phases that have already been implemented. It also allows for creativity in determining future system expansion after the Mission is experienced with the technology.

While this plan describes how to implement the MIS/GIS, the ultimate success of this effort will depend on the Mission's commitment to supporting the system in terms of long-term funding, staffing, organizational change management and training. The following are organization steps that should be taken toward implementing the recommended plan.

Organizational Next Steps to Take in the Mission:

- Form a core team in the Mission that will oversee and provide guidance of the implementation of the MIS/GIS. The team should have representatives from the program office, sector team leaders, the MIS/GIS system administrator, an M&E person, and IT staff. This core team will set system usage policies and priorities.
- Engage the USAID M/CIO/KM MPMS (Joe Gueron) about becoming a candidate for early implementation of MPMS. Determine possible implementation schedules and costs.
- Determine if an interim MIS solution is needed based on availability of MPMS system.
- Determine who will work with partners to explain purpose and train them on use of the system, assign user numbers, and facilitate selection of activity types and performance indicators with partners and their CTOs. The MIS/GIS system administrator may be a likely candidate for this role.
- Determine if any existing staff are suitable for roles outlined in this assessment. Prepare candidates for roles by arranging suitable training courses.
- Engage USAID GeoCenter early, informing them of plans for MIS/GIS and be put on their radar for products and services they will offer to missions.

Appendix A: Key Findings of CIO/KM MIS/GIS Assessment

- The MIS/GIS should be designed as a flexible, module-based solution.
    - "Lego kit" structure would allow missions to use only the modules they need and add modules in future.
    - Within modules, feature "tiers" would provide functionality from basic to more sophisticated.
- Support for generating custom reports and queries is a critical feature for the MIS/GIS.
    - An easy-to-use reporting and query tool should be part of the solution architecture.
- A table-driven data architecture will enable mission needs for flexibility.
    - Reference tables can accommodate mission-specific data element values and descriptors, such as beneficiary definitions and descriptions, status codes, etc.
    - Reference tables should enable mission-specific naming conventions and functions.
- The MIS/GIS should generate maps and enable geographic analysis at various levels.
    - Functionality needs range from basic map displays to more complex geo analytic functionality to enable program and activity planning.
    - Basic mapping and geographic data analysis functionality in its initial release and accommodate expansion for more sophisticated capabilities over time.
    - Consider having missions share best practices.
- Partners play a critical role in the success of the MIS/GIS.
    - Engage partners in early MIS/GIS mission tailoring activities.
    - Tie partner performance to timely and accurate data updates.
- MIS/GIS must provide the right balance of data capture and reporting.
    - Too much detail will be a "turn off" for users.
    - Too little detail will not provide value for management.
- MIS/GIS must be designed for ease of use with an intuitive and user friendly interface.
    - Incorporate concepts from popular commercial sites for user "stickiness."
    - Provide functions to encourage creation of the USAID "Community of Missions" including sharing of best practices via blogs and wikis.
- The MIS/GIS system must support fundamental mission efforts to track what is being done where, i.e., activities and locations.

  - Include the ability to update and view activity data via a mapping display.
  - Include "drill down" and "roll up" data display features within the map.
- Missions must identify resources responsible for MIS/GIS data collection, update and data integrity.
  - Consider a dedicated MIS/GIS administrator role at mission level.
- Leadership commitment at mission level is key.
  - CTOs and other influencers must be committed to using the proposed MIS/GIS system as the de facto source for project and activity planning, management and evaluation information.
- Continual training including on-line "refreshers" must be part of system design.
  - Accommodate staff and partner turnover as well as review of key concepts and operations.
- Security features must consider diverse users and locations.
  - Remote, yet secure, partner access is key for data updates and overall system success.
  - Network connectivity and speed may vary by mission location.
- The MIS/GIS system should enable document capture, storage, search and retrieval.
  - Provide document key word search capability.
- The MIS/GIS should interface with other USAID applications and reuse features and services as appropriate.

(from Requirements Analysis for an MIS/GIS System to Serve USAID Mission Needs Summary Briefing; Rosa Caldas, M/CIO/KM, February 9, 2011)

Appendix B: USAID MPMS Information

USAID

Mission Portfolio Management System (MPMS)

Why MPMS?

USAID Missions have made numerous requests for an information system to support the planning, management, monitoring and reporting efforts associated with the portfolio of projects they lead to deliver the Agency's goals. A critical part of the Missions' request is a solution that will streamline the inefficient reporting processes associated with responding to the significant number of requests received each week for project status and results. The Mission Portfolio Management System (MPMS) is intended to provide Mission-specific tools to streamline reporting and introduce much-needed efficiencies to the project portfolio management processes for USAID Missions.

MPMS is unique in that it:

- Is designed from the Mission perspective.
- Will be configured to fulfill requirements of each Mission, while supporting cross-Mission baseline data needs.
- Supports linkage of Mission project results to strategic goals and investments.
- Enables simple capture of Mission-specific project and activity data including indicators, beneficiaries, and locations.
- Supports mapping and display of project data to geographic locations via mapping tools.
- Provides a secure, mobile portal for Partners to input project information, including data updates, status and results.
- Enables sharing of knowledge between and among Missions and supports continuity of operations with AOTR/COTR mobility.

MPMS Key Features

- Mission-level Project and Activity management and monitoring, including real-time status of project Indicators, Beneficiaries, and other frameworks.
- On-demand, easy-to-use Reporting tools for producing graphical dashboards, scorecards and text-based reports, based on Mission-defined criteria; plus canned reports.
- Mapping of Project and Activity data to user-specified locations via a geographic "point & click" interface.
- Supports the Agency's "Results Framework" principles.
- Provides Facebook-like collaboration features to support team-based project efforts, capture.
- Enables easy capture, storage and retrieval of project documentation, including photos, videos and digital media.
- Provides secure User access via mobile devices, including iPhones, iPads and laptops.
- Enables Mission-wide information availability for improved decision making, communication, and staffing changes.

Sample MPMS Home Page

The MPMS Technology Solution

- Cloud-based technology solution based on the Force.com platform.
- Eliminates the need for special hardware & software at the Mission.
- Backups and upgrades done automatically "in the Cloud".
- Supports User & Partner access from anywhere!

MPMS is an initiative of the Knowledge Management division of the Office of the Chief Information Officer (CIO/KM). For more information on MPMS, contact Joe Gueron at JGueron@usaid.gov, David Santiago at DSantiago@usaid.gov, or Ryan Jacobs at RJacobs@usaid.gov. CIO/KM welcomes your comments / questions and suggestions.

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Appendix C: ESRI GIS Software Suite

ESRI Software Options

With the tremendous developments in both computers and the GIS software industry over the last five years, a variety of methods for deploying GIS technology now exist. The following is an overview of the primary options for providing access to GIS technology, with a focus on the corresponding ESRI software product that would be used to implement each method.

Basic Desktop Mapping Using ArcExplorer

ArcExplorer is a lightweight GIS data viewer that offers a basic type of functionality provided to the end user. In this scenario, the user is provided with ArcExplorer, which is a free standalone software product that allows the user to view, identify, locate and query geographic layers in a very basic manner.

ArcExplorer is installed locally on the end-user PC, and has the ability to access any standard ESRI data set on local disks, across a network, or across the Internet.

The advantages of this type of deployment are that ArcExplorer is free, easy to use, provides excellent performance and has very low system requirements. It is an ideal way to introduce a user to basic GIS technology. The disadvantages are that it is quite limited in available functionality and it is “read-only” (i.e., data cannot be entered or edited in any way). ArcExplorer cannot be customized.

Basic to Mid-Level Desktop Mapping Using ArcReader

ArcReader is a free desktop GIS that displays high-quality, interactive, published map files (PMF) authored using the ArcPublisher extension to ArcGIS. With ArcPublisher, an experienced GIS user can compile PMF documents linked to GIS data for distribution throughout an organization. A PMF may contain symbolized GIS data layers, scale dependent layers, images, spatial bookmarks, and joins to attribute data for use by novice GIS users. ArcReader is a deployment approach whereby both trained and inexperienced users are presented with a GIS preset for their immediate use to view, query, and print the content of a pre-formatted map document.

There are several advantages to ArcReader as a basic desktop GIS. First, PMF documents can be published to read data from a CD-ROM or a network drive. Second, a wide range of data formats (vector data, orthoimagery and other data) can be combined and symbolized in a manner that is consistent and intuitive for the organization. Additionally, PMFs can be customized to present only selected tools and functions to reduce the learning curve for inexperienced users of a GIS.

The main disadvantages to ArcReader are that PMF documents require time and resources to compile in ArcPublisher by an experienced GIS user, and they cannot be modified by the end user. ArcPublisher is an extension to ArcGIS (see description below) and is an additional software purchase. Finally, ArcReader will require training for users completely inexperienced with GIS desktop applications, and tends to be a more appropriate solution for organizations with a small number of users already acquainted with GIS (especially ArcGIS products.)

Fully Functional Desktop GIS Using (ArcGIS) ArcView

This mode of deployment uses ArcView, a full-scale desktop geographic information system. ArcView allows the user to perform the full suite of operations required in a desktop GIS environment, including data entry and editing, a significant number of spatial query and analysis functions, geocoding, and advanced display.

ArcView (version 9.x) is part of the ArcGIS suite of products, which uses object oriented system architecture. The primary ArcGIS products are ArcView, ArcEditor, and ArcInfo. There is a high degree of compatibility and similarity between these three products, with ArcView providing a base level of functionality followed by ArcEditor, and ArcInfo. Customization of ArcView is accomplished using Visual Basic for Applications programming language or other common object-oriented programming languages, such as Visual Basic and C++.

This type of deployment is most appropriate when there are a small number of end users for a particular application (<12) and the users need access to a significant number of GIS functions. The disadvantages of this type of deployment are the relatively high cost per seat (~$1,200+), the higher degree of technical expertise required by the end user, and the need for programming skills for software customization.

High-End Desktop GIS Using (ArcGIS) ArcEditor

ArcEditor is similar to ArcView with the addition of advanced data creation and editing tools, including topology, subtypes, and domains. ArcEditor provides an experienced and trained GIS professional with a set of tools to construct GIS features based on sophisticated data models that express topological relationships and attribute relationships. ArcEditor is the required desktop GIS for developing and maintaining GIS data that requires a sophisticated data model (such as tax parcels). ArcEditor also allows creation and editing of an enterprise geodatabase. In an enterprise geodatabase, GIS data is stored in a relational database management system (RDBMS) that is spatially enabled using ESRI's ArcSDE technology. ArcEditor is also used to administer tasks in ArcGIS Server.

High-End Desktop GIS Using (ArcGIS) ArcInfo

ArcInfo is among the most robust GIS software packages in the world, designed specifically for the sophisticated GIS professional. It provides the user with nearly 3,000 GIS functions and operations, many of which are not available in any other ESRI software product. ArcInfo desktop is particularly powerful in advanced data creation and editing, sophisticated geographic analysis, and in representing complex features. ArcInfo is also used to administer ArcGIS Server applications.

This software is typically required only by dedicated GIS professionals with a strong background in GIS technology. Of the products listed here, ArcInfo is the most expensive per seat, and is therefore only appropriate if there is a clear need and a skilled user able to exercise the full power of the software. ArcInfo (or ArcEditor) is required when using an enterprise geodatabase within the organization.

Component-Based GIS using ArcObjects

This method of deployment involves leveraging existing GIS functionality embedded within the ESRI ArcGIS Desktop products (e.g., the ArcGIS suite of applications) through the development of custom-programmed interfaces. ArcObjects is a set of programming components that allow application developers to "embed" GIS functionality and operations – geographic data management, spatial editing, spatial analysis, and cartographic display – in custom programs.

The MPMS system is utilizing ArcObjects technology to incorporate mapping into the main MPMS dashboard screens. Though they require specialized program skills, it would be possible to build additional USAID/DRC custom map views directly into MPMS.

Component-Based GIS Using ArcEngine

ArcEngine is a deployment method for ArcObjects. ArcEngine can be used to develop a custom desktop application that is either standalone or imbedded in another application. It does not require a license for an ArcGIS desktop product. The cost per seat is based on the level of functionality, starting at about $500. ArcEngine is a good solution for an organization that requires a sophisticated, highly customized GIS application that will be used by a fairly large number of users.

ArcServer

ArcServer uses ArcObjects to provide server-based advanced data editing and analysis capabilities. An ArcServer application can provide desktop-level GIS functionality over an organization's intranet or across the Internet. ArcServer is designed for centrally managed organizations with a wide variety of needs and a large number of users. Previously, ArcServer required advanced database management skills, high-level programming skills, and a significant financial investment. However, with the release of ArcGIS 9.2, ArcGIS server has become more user friendly, with more out-of-the-box functionality. Additionally, there are now three levels of functionality, making it more affordable and accessible to many organizations.

Internet/Intranet Deployment Using ArcIMS

ArcIMS allows GIS functionality to be deployed via common Internet browser software such as Internet Explorer or Netscape. This product allows a GIS application to be developed that resides on a shared server (map server). The GIS application simply provides the "engine" to perform spatial display, query and analysis; however, the graphics and interaction with the end user is done via HTML or Java documents served through a standard browser. The user points and clicks within an HTML or Java document in their browser, which sends a specified request to the map server (engine). The map server then performs the required operation (e.g., zoom in) and sends the result back to the user in the form of a new HTML or Java document (e.g., with a JPEG image of the newly zoomed in map). This method can be used seamlessly in an Internet or Intranet environment.

This type of deployment is rapidly gaining popularity in many organizations due to several distinct advantages. These advantages include the ability to deploy a custom application to an extremely large number of end users (unlimited) without using any software other than a standard browser on the end user machine. This method of

deployment represents an extremely low cost per seat, since the ESRI software license is priced on a per map server CPU basis. Therefore, a very large number of end users can be provided access to an application at a fixed price. This option also results in significantly less network traffic than other methods. Additionally, it provides a central point of administration via the map server. More specifically, the system administrator can provide an update to the application by simply posting a new version of the application on the map server – similar to a mainframe environment. However, this mode of deployment also offers significantly slower performance than any other options discussed due to the lack of local resources – all computations are performed on the map server, along with the requests from all other users. For example, a simple zoom-in operation on a map display, which any typical GIS software package described above will perform with sub-second response, can take up to 10 seconds using this method depending on server or network traffic. Another advantage of ArcIMS is the current set of limitations with functionality such as data editing, map output, and advanced analysis. However, it is expected that, as this technology continues to mature, these limitations will be addressed.