Final Report

Requirements And Cost Benefit Analysis Managing Geospatial Data For Better Program Delivery A Service Center Initiative

Prepared for
United States Department of Agriculture
Natural Resources Conservation Service
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Executive Summary

The focus of this study is the three Service Center Agencies of the United States Department of Agriculture (USDA) and the work was undertaken on behalf of the following partner agencies:

- Natural Resources Conservation Service (NRCS) and Conservation District (CD) partners.
- Farm Services Agency (FSA).
- Rural Development Agencies (RD).

The three Service Center Agencies share a common high-level mission to enhance the quality of life for the American people by supporting agricultural production while upholding a healthy and productive nation in harmony with the land. Although the mission is the same, the individual business requirements vary from one agency to another. The FSA supports American agriculture through commodity, disaster, and loan programs; NRCS and Conservation Districts emphasize research, technology and natural resource conservation; and the RD agencies provide social and financial services to rural areas.

The tasks for this study were:

- Review and validation of the business requirements of the three Service Center Agencies and partners.
- Identification of emerging technologies that will affect Geographic Information Systems (GIS) in the next 5 to 10 years.
- Development of potential Geospatial Information Architectures (GIA) for the three Service Center Agencies and partners.
- Estimation of benefits, life-cycle costs, and other financial metrics for potential GIAs.
- Development of recommendations regarding GIAs that are balanced among the technological, cost benefit and cultural/political realities of the organizations.

A number of USDA documents related to geospatial information were reviewed and analyzed. While the documents contained many descriptions of processes and numerous functional requirements, no document contained a definitive set of business requirements. Through a thorough review of all available documentation and interview information, a set of business requirements were developed that accurately reflect the needs of the USDA.

Interviews were conducted in order to validate the documented information related to business requirements. Participants from executive, scientific, and technical backgrounds and delegates from federal, state, and local levels were represented among the interviewees. Eighteen interviews consisted of representatives from the FSA, NRCS, and RD. Additional information was acquired from three interviews that involved members from the Information Technology Working Group (ITWG), the Conservation Districts (CD), and the Office of the Chief Information Officer (OCIO).

The business requirements identified in the interviews were generally consistent with the business requirements identified in the documentation. Common requirements prevailed, regardless of agency affiliation or business mission. Most of the respondents were oriented to descriptions of functional requirements and missions rather than business requirements. The identified business requirements are shown in Table E-2 below.

Three other issues were addressed with varying frequency in documentation and by the interviewees. The first of these was customer satisfaction surveys that identified requirements that may be met, in some cases, by GIS and geospatial data. In addition, the Service Center Agencies' requirement for 19 data layer themes to successfully administer programs was identified. Finally, training was emphasized as urgent more often than any other requirement. It was regarded as a fundamental ingredient to successfully accomplishing business missions and meeting customer needs.

It is recognized throughout the documents that GIS and geospatial data are critical in the success of USDA. Currently, the processes that rely upon geospatial data to deliver services in the Service Centers often use manual cartography and map use technologies that are outmoded, prone to error and incredibly time consuming. The

Service Center Agencies expect to meet the requirements of Executive Order 12906, OMB Circular A-16, and the Electronic Freedom of Information Act (E-FOIA) amendments of 1996 as well as the Government Paper Work Elimination Act (GPEA) and Freedom to E-File Act through the use of GIS and shared geospatial data.

GIS technology innovations coming in the near future could affect how the USDA Service Center Agencies accomplish their business missions. The eleven emerging technologies identified in the study are:

- Wireless technology.
- The web.
- "Near-Me" technology.
- Voice and handwriting recognition.
- Natural language processing.
- Handheld device convergence.
- Data enrichment.
- Digital signature and encryption.
- Adaptive software.
- Peer to peer communication.
- Terminal server technology.

Following the analysis above, alternative architectures were defined using the information gathered from the literature, interviews, and practical experience in defining similar architectures. The alternative architectures are:

- Alternative 1 - Static Baseline With No New Acquisitions (As-Is).
- Alternative 2 - To-Be Distributed Alternative.
- Alternative 3 - To Be Centralized Alternative.
- Alternative 4 - To-Be Mixed Alternative.

A high level assessment of each alternative architecture was made and is presented in Table E-1 below. As can be seen, the To-Be Distributed and To-Be Mixed Alternatives provide the best solutions as they have a better ratio of pros to cons.

Table E-1: Pros and Cons of Each Architecture Alternative

Pros	**As-is**	**To-Be Distributed**	**To-Be Centralized**	**To-Be Mixed**
USDA has already made an investment in local servers.	✓	✓		✓
Much of the GIS business data will be created and updated locally.	✓	✓		✓
Minimized the usage and dependency of the WAN.	✓	✓		
Provides the richest and fastest set of GIS functionality to the local user, partners and customers.		✓		✓
Provides ability to use local data.	✓	✓		✓
User desktop speed it is not dependent on WAN load.		✓		✓
Centralized Data Management and System Administration			✓	✓
Easier to aggregate data centrally			✓	✓
Supports access of transaction based GIS data outside Service Center Office			✓	✓
Centralized deployment of applications			✓	✓
Cons	**As-is**	**To-Be Distributed**	**To-Be Centralized**	**To-Be Mixed**
Maintaining a local GIS application and spatial database server is marginally more expensive and resource intensive than a purely centralized architecture.		✓		✓
In a purely distributed architecture data aggregation requires more work due to the inevitable differences between data coming from multiple counties (i.e. duplication of records, edge matching, gaps, etc.).		✓		
Deployment of distributed applications is marginally more costly than deployment of purely centralized applications. Central software distribution nodes or web based delivery mechanisms can lessen the cost of deployment, however, it will not eliminate the need for local intervention of the process.		✓		✓
Highly dependant on the bandwidth and availability of the WAN for performing daily business.			✓	
Rich GIS functionality not available. Does not empower employees to use COTS.	✓		✓	
Speed at users desktop is variable depending on WAN load.			✓	
Reduces the functionality and thus the benefits for Service Center Staff and Partners.	✓		✓	
Does not accommodate the need for local data from remote applications.	✓		✓	
Does not support local applications.			✓	

The business requirements were also mapped against the alternative architectures. Table E-1 shows the benefit each business requirement will receive from a particular alternative expressed as a percent. The percentages are assigned based on the knowledge of the various alternative architecture capabilities. The averages show that the As-Is Alternative will not support more than 25% of the business requirements while the To-Be Mixed Alternative is estimated to support 100% of them. The To-Be Distributed and To-Be Centralized Alternatives are estimated to support about 80% to 85% of the business requirements.

Table E-2: Business Requirements vs. Alternative Architectures With Benefits Expressed as a Percent

Service Center Agencies Business Requirements	Geospatial Information Architecture (GIA)			
	As-Is	To-Be Distributed	To-Be Mixed	To-Be Central
Conduct outreach and community relations	25%	75%	100%	75%
Provide customer and management with information	25%	75%	100%	75%
Process FOIA request	25%	75%	100%	80%
Conduct disaster assessment	25%	50%	100%	100%
Conduct and share natural resource inventories	75%	50%	100%	100%
Determine land eligibility	25%	100%	100%	75%
Determine acreage area	25%	100%	100%	100%
Determine cropping history	10%	75%	100%	100%
Determine environmental ranking	10%	100%	100%	75%
Conduct on site inspection	25%	100%	100%	25%
Determine applicable practices	25%	100%	100%	50%
Determine schedule of application	25%	75%	100%	25%
Review plan with customer	25%	100%	100%	25%
Process AD245	25%	100%	100%	100%
Provide AD862	25%	50%	100%	100%
Conduct review to ensure compliance	25%	100%	100%	100%
Perform status review	25%	100%	100%	100%
Support local and state conservation committees	25%	100%	100%	100%
Implement geospatial information training	10%	100%	100%	100%
Configuration manage, protect, monitor and report geospatial data status and integrity	50%	75%	100%	100%
Support integration of customer and program information across agencies and programs	10%	75%	100%	100%
Support integration of GPS and imagery (satellite to 35 mm digital slides) data into program processes	10%	100%	100%	25%
Support all applicable Federal information processing and geographic information standards, particularly those determined by the FGDC as supporting the NSDI	20%	50%	100%	100%
Support changing programmatic guidance, dataset requirements and system scale changes	25%	75%	100%	85%
Average	25%	83%	100%	80%

Costs involved in maintaining the current As-Is Baseline Alternative and the costs of the three To-Be Alternatives were projected over a 10-year lifecycle cost estimate (LCCE). As the report is not a budgetary document, the costs do not reflect actual budget allocations or constraints. The analysis represents the total 10-year cost of ownership of GIS. It presents the cost of the resources that would be allocated towards effectively implementing and maintaining each alternative. However, this does not mean that the costs are necessarily over and above current budget allocations. The funding for these resources may result in a request for increased funding, a reallocation of current resources, or could already be accounted for in current funding levels. Table E-3 presents the discounted 10-year LCCE for the baseline and the three alternatives.

Table E-3: Discounted 10-year LCCE for the Baseline and Three Alternatives ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
As-Is Baseline	$147.1	$5.6	$5.5	$5.3	$5.1	$4.9	$4.8	$4.6	$4.5	$4.3	$4.2	**$195.9**

To-Be Distributed	$147.1	$54.4	$84.8	$79.8	$79.5	$81.0	$68.9	$56.7	$56.8	$53.7	$51.2	**$814.0**
To-Be Centralized	$147.1	$54.7	$105.4	$110.7	$118.3	$127.2	$122.0	$107.3	$105.8	$101.2	$97.2	**$1,196.9**
To-Be Mixed	$147.1	$62.1	$112.5	$114.3	$121.8	$130.6	$125.2	$110.5	$108.9	$104.2	$100.1	**$1,237.4**

As is clearly evident, GIS represents a significant investment. The To-Be Mixed Alternative has the highest cost because, to achieve full functionality, it is necessary to make investments that enable both a centralized and distributed solution. The main difference between the To-Be Distributed and To-Be Centralized alternatives results from the large telecommunications investment required for increasing current bandwidth at each Service Center in order for centrally deployed data and applications to work effectively.

Benefits derived from the implementation of GIS technology at the USDA were also determined. The benefits are broken down into three categories:

- Internal Benefits that accrue directly to the USDA.
- External Benefits that apply to the USDA's customers.
- Non-quantifiable Benefits, which are real benefits that accrue to USDA and its customers that are not easily translated into monetary values or that cannot be quantified with a sufficient level of accuracy.

The benefits were estimated over a 10-year lifecycle beginning in FY01. Benefits do not begin accruing until at least a portion of the system is deployed. The baseline and each of the three alternatives have a different level of benefits that is directly correlated to the level of GIS functionality available in each scenario. Table E-4 presents the 10-year discounted benefits stream for the baseline and the three alternatives. It is a compilation of internal (NRCS, FSA, RD, and CD) and external benefits.

Table E-4: Discounted 10-year Benefits for the Baseline and Three Alternatives ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
As-Is Baseline	$2.1	$8.2	$10.9	$13.4	$15.8	$18.0	$17.5	$16.9	$16.4	$15.9	**$135.1**
To-Be Distributed	$21.1	$81.9	$109.1	$134.4	$158.0	$180.1	$174.6	$169.1	$163.9	$158.8	**$1,351.2**
To-Be Centralized	$18.1	$70.2	$93.4	$115.0	$135.2	$154.2	$149.4	$144.8	$140.3	$135.9	**$1,156.5**
To-Be Mixed	$24.1	$93.4	$124.3	$153.2	$180.1	$205.3	$199.0	$192.8	$186.8	$181.0	**$1,540.0**

As is clearly seen, the To-Be Mixed Alternative has the greatest benefits since it provides the USDA with the greatest functionality.

Non-quantifiable benefits are benefits that are realized but cannot be quantified due to the qualitative nature of the benefit or the lack of available data to make a sufficiently accurate estimation. For example, quality of life and improved employee morale cannot be quantified with a high enough level of confidence to be included in any calculations. Nevertheless, these benefits can be an extremely significant factor in an investment decision. GIS provides several benefits that accrue to both the USDA and its customers but are difficult to assess quantitatively. These non-quantifiable benefits further support the argument for GIS.

The CBA results support the investment in GIS for all three alternatives. However, the case is much stronger for the To-Be Distributed and To-Be Mixed Alternatives:

- The net present value (NPV) measures the difference between discounted benefits and discounted costs as compared to the baseline. An NPV above zero indicates a worthwhile investment. In this analysis, all three had a positive NPV.

- The benefit-cost ratio (BCR) is calculated by dividing the benefits by the costs. Values greater than one indicate a worthy investment. The BCR for all three alternatives is greater than one.

- The internal rate of return (IRR) calculates the discount rate at which NPV equals zero; that is, the rate at which the present value of benefits equals the present value of costs. Any rate above the discount rate used indicates a worthwhile investment. All three alternatives had an IRR that exceeded the OMB discount rate.

- The payback year represents the year in which the sum of the benefits is greater than the sum of the costs. All three alternatives have a payback year that occurs within the 10-year LCCE.

Table E-5 summarizes the risk-adjusted CBA results without non-quantifiable benefits. When non-quantifiable benefits are considered, the case in favor of GIS only becomes more convincing.

Table E-5: Discounted Cost and Benefit of Each Alternative

	Point Estimate	Risk Adjusted Mean Value
Baseline LCCE (PV $M)	$195.9	$195.9
Distributed LCCE (PV $M)	$814.0	$815.7
Centralized LCCE (PV $M)	$1,196.9	$1,199.3
Mixed LCCE (PV $M)	$1,237.4	$1,239.8
Baseline Benefits (PV $M)	$135.1	$135.1
Distributed Benefits (PV $M)	$1,351.2	$1,351.1
Centralized Benefits (PV $M)	$1,156.5	$1,156.4
Mixed Benefits (PV $M)	$1,540.0	$1,539.9

Typically, investment decisions are based upon NPV results while the IRR, BCR, and payback year provide insight into an investment's value. Table E-6 summarizes the NPV, BCR, IRR, and payback year of each alternative compared to the As-Is Baseline.

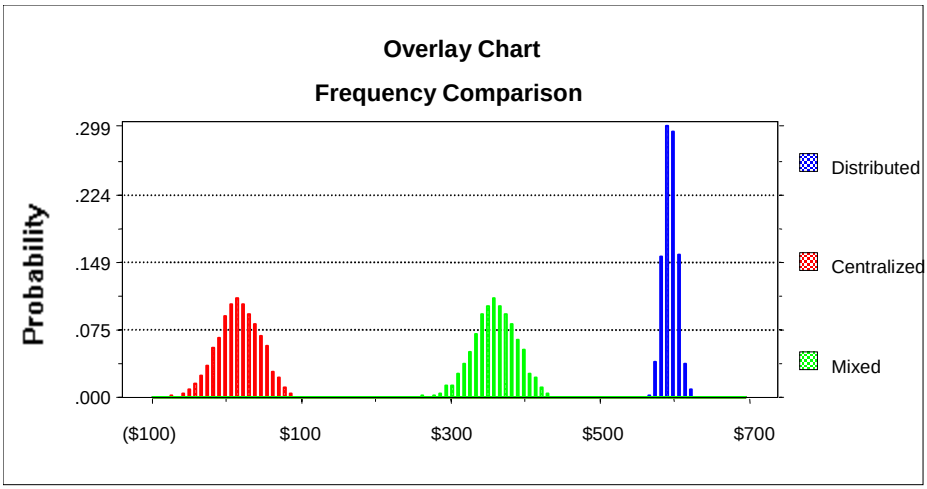
Table E-6: CBA Results Compared to the As-Is Baseline, including Sunk Costs

Alternative	Baseline NPV vs. Alternative – Point Estimate (PV $M)	Baseline NPV vs. Alternative – Risk Adjusted Mean Value (PV $M)	BCR – Point Estimate (PV $M)	BCR – Risk Adjusted Mean Value (PV $M)	IRR	Payback Year
To-Be Distributed	$597.9	$596.1	1.97	1.96	86%	2004
To-Be Centralized	$20.3	$17.8	1.02	1.02	6%	2010
To-Be Mixed	$363.4	$360.8	1.35	1.35	49%	2005

As is clearly indicated from the above tables, an investment in GIS technology using any of the alternatives will benefit the USDA.

After the costs and benefits were defined, a financial risk analysis was conducted. Over a 10-year lifecycle, there is uncertainty and risk with cost and benefit calculations. Figure E-1 combines the NPV of the three To-Be Alternatives. As shown, the Distributed Alternative has a greater quantifiable benefit than the other two alternatives. Moreover, the difference between the upper and lower boundaries for the To-Be Distributed Alternative is much narrower than for the other two alternatives, indicating less risk. This is largely due to the additional risk inherent in a total or mixed centralized solution. The main risk factor in the To-Be Centralized and To-Be Mixed Alternatives arises from the telecommunications costs.

Figure E-1. Overlay Chart of To-Be Alternatives' Net Present Values



Summarizing:

- Based on the cost-benefit analysis the investment in either the To-Be Distributed or To-Be Mixed Alternatives will greatly benefit the Service Center Agencies. However, the monetary benefit of the To-Be Distributed Alternative is significantly superior.

- The To-Be Mixed Alternative is the technically superior solution as it allows selective exploitation of the advantages found in both the To-Be Distributed and To-Be Central Alternative Architectures. For the same reason, the To-Be Mixed Alternative also supports all of the business requirements. The To-Be Distributed Alternative is financially superior, but does not meet all of the business requirements and has issues involving system maintenance, data aggregation and applications deployment.

- Organizationally, the current situation is that the government is proceeding with the purchase and deployment in the near term of a To-Be Distributed Alternative. This alternative is proceeding based on CCE architecture decisions to meet the need for email, file services, etc. and are not being driven by GIS. However, based on this, the To-Be Distributed Alternative is also the best organizational solution. This would seem to make the other alternatives, at least temporarily, moot.

In conclusion:

- The As-Is Alternative is not an acceptable solution. It supports only 25% of the business requirements. It also has a negative cost benefit relationship as it costs about $60 million more than it returns and it has a number of technical weaknesses.

- The To-Be Centralized Alternative is consistently the third choice. The To-Be Distributed Alternative is clearly the best choice financially and organizationally. It ranks second technically as it does not support all of the business requirements and has a weaker ratio of technical pros to cons than the To-Be Mixed Alternative. However, its financial superiority, the organizational realities and its strong showing as the second choice in the technical areas make the To-Be Distributed Alternative the recommended choice.

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Introduction

Scope of Work

This report is the result of work performed under Natural Resources Conservation Service (NRCS) Task Order NRCS-ITAT-01-01 USDA Requirements and Cost Benefit Analysis: Managing Geospatial Data for Better Program Delivery - A Service Center Initiative. The focus of the work was the three Service Center Agencies of the United States Department of Agriculture (USDA) and the work was undertaken on behalf of the following partner agencies:

- Natural Resources Conservation Service (NRCS) and Conservation District (CD) partners
- Farm Services Agency (FSA)
- Rural Development Agencies (RD)

The scope of this study was to develop a comprehensive requirements and cost-benefit analysis report addressing the management of geospatial data for better program delivery. The study addressed principal business requirements of the three Service Center Agencies and partners. The scope of this study encompassed the analysis of bottom line implications and costs associated with managing geospatial data for better program delivery in these three agencies. The principle objectives addressed included:

- Review and validation of the business requirements of the three Service Center Agencies and partners.
- Development of potential Geospatial Information Architectures (GIA) for the three Service Center Agencies and partners.
- Articulation of benefits, investment levels and associated life-cycle costs, and payback ratios for the potential GIAs.
- Development of recommendations regarding GIAs that are balanced among the technological, cost benefit and cultural/political realities of the organizations.

The ultimate objectives for this report were for it to be a communications vehicle for addressing how the government responds to a targeted geographical information system architecture and, additionally, to justify and support the business case for additional funding and investments for future fiscal years. The results form the Information Technology component of the Service Center Modernization Initiative (SCMI-IT) and will be presented to congressional and departmental staff regarding the implementation of the Geospatial Information Architecture. Furthermore, this report will be used to communicate plans for geospatial data management and Geographic Information System (GIS) implementation to agency staff at all levels. The final report will be used as a communications vehicle for how the Government plans to move to the targeted GIA(s).

A review of Government Furnished Information (GFI) was followed by 21 informational interviews, conducted to obtain current information related to business requirements. Interviews consisted primarily of representatives from FSA, NRCS and RD, with additional information provided by representatives from the Information Technology Working Group (ITWG) and the Conservation Districts. Participants came from technical, scientific, and executive backgrounds and represented the national, state, and local levels of the organizations.

The emerging technologies that could be implemented and that will affect GIAs in the next 5 to 10 years were then identified. A set of possible architectures was defined and a cost benefit

analysis was conducted for each of the architectures. This was followed by the evaluation of the technical, economic and cultural/political factors impacting the architectures and the development of a recommendation for a GIA for the three Service Center Agencies.

Business Areas

The three Service Center Agencies share a common high-level mission to enhance the quality of life for the American people by supporting agricultural production while upholding a healthy and productive nation in harmony with the land. The mission is met by caring for privately held agricultural, forest, and range lands; ensuring accessible, affordable, nutritious, and safe food supply; expanding global markets for agricultural and forest products and services; providing economic opportunities for farm and rural residents; supporting sound development of rural communities; and working to reduce hunger in America and throughout the world.

Although the mission is the same, the individual business requirements vary from one agency to another. The FSA supports American agriculture through commodity, disaster, and loan programs; NRCS and Conservation Districts emphasize research, technology and natural resource conservation; and the RD agencies provide social and financial services to rural areas.

Farm Service Agency

The mission of the FSA ensures the well-being of agriculture, the environment, and the public through conservation, disaster programs, domestic and overseas food assistance, efficient and equitable administration of commodity programs, and the granting of emergency loans in order to improve the economic stability of agriculture and the environment. These programs provide a safety net to help farmers compete for export sales of commodities in the world marketplace, contribute to the year-round availability of a variety of low-cost, safe, and nutritious foods, maintain viable operations, and produce an adequate food supply. FSA also enhances the environment by the development and implementation of programs to support protection of our natural, cultural, and historic resources.

Natural Resources Conservation Service and Partners

NRCS provides National leadership in a partnership effort to help people conserve, improve and sustain America’s natural resources and environment. The agency provides technical assistance and information to individuals; communities; tribal governments; Federal State and local agencies; and others. The NRCS partners with the local conservation districts, state agencies and volunteers. NRCS also offers financial assistance, surveys the Nation’s soils, inventories natural resource conditions and use, provides water supply forecasts for the Western States, and develops technical guidance for conservation planning.

NRCS delivers technical programs and financial assistance in partnership with FSA to help conserve, improve, and sustain the environment and natural resources. NRCS and the CDs recognize that members have independent responsibilities for sustaining the environment and conserving the nation's natural resources but are dependent upon one another for the successful delivery of programs that will help realize their common vision of a productive nation

in harmony with a quality environment. The CD coordinates assistance from all available resources (public, private, local, state and federal) in an effort to develop locally driven solutions to resource concerns.

Rural Development Agencies

RD missions seek to improve the economy and quality of life of rural America by creating quality housing and a vibrant rural business sector, and by ensuring that rural areas are served by utilities and the information superhighway. The RD agencies are committed to support business, housing, and utility services in rural communities by funding housing programs, providing loans and grants for rural infrastructure projects, and by providing technical and financial assistance to rural businesses and cooperatives. The constituent agencies are:

- Rural-Business Cooperative Service (RBS) – makes loan guarantees or direct loans for projects that preserve or create quality jobs and promote a clean rural environment.
- Rural Housing Service (RHS) – provides loans and grants that help families secure quality housing.
- Rural Utilities Service (RUS) – helps to finance electric, telecommunications, water, and wastewater facilities that serve rural areas.
- Office of Community Development (OCD) – administers the Rural Empowerment Zones and Enterprise Communities program, which provides revitalization for economically depressed rural areas.

Cultural, Legislative, and Political Considerations

This study is primarily a technical and cost benefit analysis. However, in evaluating solutions and securing recommendations, cultural, legislative, and political aspects of the operational environment need to be considered.

Cultural Aspect

Although the ultimate mission of the three Service Center Agencies is the same, the differences in culture emanate from the business requirements and the organizational histories that are unique to each agency. Such cultural disparities could potentially pose limitations on the overall outcome and success of a multi-agency GIA unless they are part of the solution definition and assessment.

The FSA is structured from the top level down and unionized. Agency programs involve the transfer of large sums of money, which dictates financial control and strict procedures to avoid fraud, waste and abuse. There is a programmatic focus to the responsibilities. Experience with geospatial information and technology has been relatively limited for the rank and file, but is growing rapidly.

The NRCS was founded as a grassroots organization and is decentralized. Staff tend to be more scientifically and technically educated within the NRCS and partnership groups. Procedures are present but the responsibilities are met by working in the field with individuals. A great deal of independence of action is permitted and encouraged. Exposure to geospatial information has been increasingly implemented throughout the agency.

The RD agencies are structured from the top level down and are both very centralized and heavily unionized. Staff functions tend to be focused primarily on the overall well being of people in rural areas, dealing with the distribution of social and financial services. Exposure to technical advancements regarding geospatial information has been limited to a few members of the organization at the headquarters.

The varied views of control and flexibility and the disparate experience with geospatial infrastructures must be considered in evaluating solutions and securing recommendations for a GIA.

Legislative Aspect

Several recent legislative acts have influenced the focus of the three Service Center Agencies. Acts that were passed, or are pending, and that play a major role in determining the present and future courses of action include:

- Clinger Cohen Act of 1993 – Requires the USDA to leverage information technology to maximize efficiencies of program delivery and better manage information technology implementation risk and reporting. The act requires government to operate as an efficient and profitable business would operate. It also emphasizes development of an integrated framework of technology.

- Department of Agriculture Reorganization Act of 1994 – Mandates modernization and requires the USDA to consolidate field offices and manage information technology in a manner that enhances productivity, customer service, and information sharing. It emphasizes streamlining of functions within the USDA.

- Government Paperwork Elimination Act of 1998 – Requires the USDA to move to a self-service, web-enabled environment by 2003 in order to reduce time-consuming and duplicative paperwork. The act requires the USDA to provide options to submit information and keep records electronically whenever feasible.

- Freedom to E-file Act of 2000 – Requires basic web access to USDA forms and applications by December 2000 and web capabilities supporting the receipt of electronic customers by June 2002. It requires USDA to establish an electronic filing and retrieval system to enable the public to electronically file all required paperwork and to have access to public information.

- Farm Bill of 2002 – The next United States farm bill is due in 2002. In addition to changes in Agricultural policy, the bill is likely to drive new business and functional requirements for the Service Center Agencies. Farm bills are meant to address pressing issues and concerns involving agriculture, conservation, rural development, and business regulations for both the customer and the agency. The Farm Bill can also be a vehicle for Congress to direct the manner in which the three Service Center Agencies organize themselves and implement technologies to fulfill their missions.

- OMB Circular Number A-130 – The OMB Circular A-130 Management of Federal Information Resources establishes policy for the management of federal information resources and includes procedural and analytic guidelines for implementing specific aspects of such policies and appendices of the following key areas:

    - Federal agency responsibilities for maintaining records about individuals.
    - Implementation of government paperwork elimination.
    - Security of federal automated information resources.

The varied legislative and over site requirements must be considered in evaluating solutions and securing recommendations for a GIA.

Political Aspect

The three Service Center Agencies and their partners share a common clientele and compatible missions. However, the services provided and the manner in which they are provided varies among the agencies and can, at times, result

in differences that appear to generate an atmosphere marked by competition and proliferation of technologies rather than cooperation and integration of resources.

These varied operational cultures and individual organizational concerns must be considered in evaluating solutions and securing recommendations for a GIA.

Methodology

The methodology for this study was designed to address the principle objectives identified in the previous section. These are the review and validation of business requirements, development of candidate GIAs, cost-benefit analysis, evaluation of future technologies and development of recommendations.

Review and Validation of Business Requirements

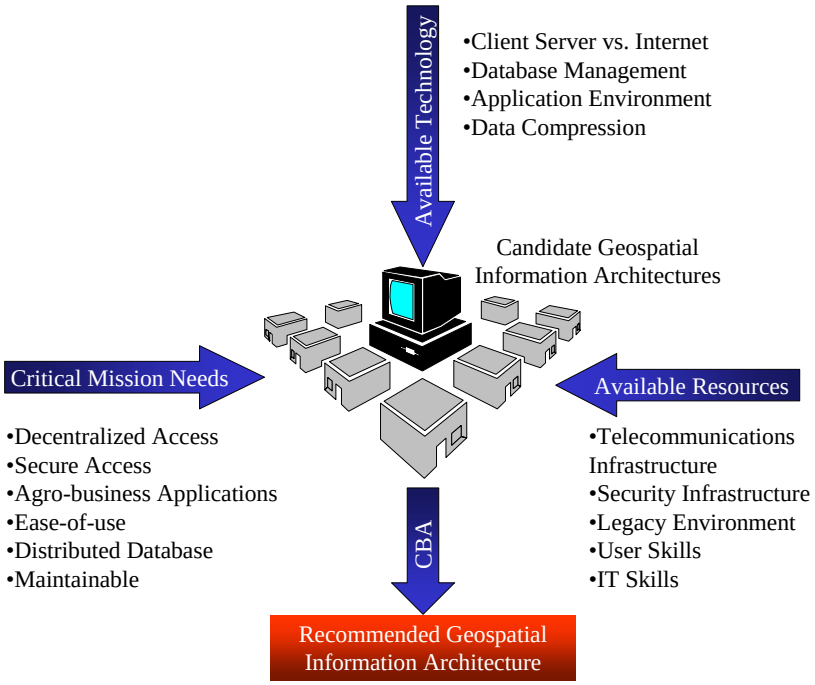
The objective of this portion of the study was to identify and validate the business requirements of the three Service Center Agencies. An initial review of GFI documentation was followed by the development of a set of questions and interview materials. Additional documentation was identified in the course of the interviews. Twenty-one interviews were conducted with members of the three Service Center Agencies and the CD. Interviewee information is provided in Appendix A. Questions and interview materials are provided in Appendices B and C.

The interviews addressed each Service Center Agency's current resources, geospatial requirements, and specific GIA strategies that would meet the business needs. The geospatial information requirements were found to vary widely, ranging from very specific functionality (e.g. which scientific models to implement) to enterprise level needs (e.g. ability to access data from anywhere). An abstract of the content of the interviews is provided in Appendix D. Appendices G and H provide an acronym list and a bibliography of the documentation.

Development of Candidate Geospatial Information Architectures

In this portion of the study, several candidate GIAs were developed based on the requirements and possible political and funding scenarios. Figure 0-1 illustrates the approach used to postulate candidate Geospatial Information Architectures.

Figure 0-1: Architecture Development Method



The Candidate Geospatial Information Architectures were selected and designed to achieve USDA's objectives and meet the requirements. Each technical alternative employs a different technology or strategy that considers the following:

- Available technology.
- Critical mission needs.
- Resources available to support the architecture.

Due to the variability of these factors, the architecture alternatives represent "snapshots" of GIA capability across the agency at a discrete moment. A holistic view took into consideration the prioritization of the requirements for meeting the mission needs. In addition to the purely technical factors, technology trends and organizational realities such as limited bandwidth, security, computing systems capacity, impacts of deployment on limited resources (i.e. training, change management, etc) were considered.

Cost Benefit Analysis

Once the GIAs were developed they were subjected to a cost benefit analysis (CBA). CBA answers the broadly defined question: "Which investment alternative maximizes the difference between discounted benefits and costs?" In doing so, this investment analysis focuses on general resource allocation questions. It is important to distinguish a CBA, which is an investment decision tool, from a budget, which is a resource allocation tool. The CBA incorporates investment analysis methods to identify financially superior alternatives. This section presents the methodology used to estimate benefits, costs, conduct risk and sensitivity analysis, and rank alternative investments.

The CBA consolidates cost and benefit estimates into investment decision criteria. These criteria are standard to public investment analyses and comply with federal guidance. An investment's financial worth is best measured by its net present value (NPV). NPV is the present value of benefits minus the present value of costs. The technical alternative with the greatest NPV is the most financially acceptable investment.

A common secondary measure is the internal rate of return (IRR), defined as the discount rate at which the present value of benefits equals the present value of costs. Use of IRR is a more precise definition than the generic term rate of return (ROR) since ROR could refer to either a return on investment (ROI), accountant's rate of return (ARR), or IRR. It is important to clearly distinguish among the three because each is calculated differently and has a different meaning. Therefore, IRR is used to clearly indicate the type of ROR calculation employed in the CBA methodology. A third measure often utilized by government agencies is the benefit cost ratio (BCR). This measure is calculated by dividing the present value of benefits by the present value of costs. A ratio greater than one indicates the project is worthwhile. A sensitivity and risk analysis establishes a range of potential outcomes to the investment decision by changing key inputs.

The cost and benefit data were collected from existing USDA reports and through interviews. The costs and benefits for both the baselines and alternatives were estimated over a 10-year lifecycle. A real 10-year discount rate of 3.2% was used in calculating all present value figures, as established by 2001 OMB Circular No. A-94.

The first step of the analysis was to determine the cost of the As-Is baseline. The baseline (As-Is: No Investments) assumes that the USDA will not make any further investments in GIS technologies. The only costs incurred are associated with maintaining the functionality of the tools currently used to perform GIS tasks. O&M includes the hardware, software, personnel, and other costs associated with maintaining the functionality of the baseline.

It is acknowledged that an As Is: No Investments alternative will result in major investments in other areas, such as in technology at the FSA Aerial Photography Field Office (APFO) to create the scale photography that is currently fielded. In addition, it will require a significant investment in technology at the Service Center Agency offices to replace planimeters, an outmoded technology, used for compliance. However, these costs are very difficult to estimate. Rather than over inflating the costs, a very conservative estimate was made and included in the analysis.

Three alternatives were estimated for the To-Be scenarios. For each alternative, the costs were separated into recurring and non-recurring costs. The non-recurring costs contain the investment costs for implementing and

deploying each alternative. The recurring costs cover all the necessary O&M costs needed to preserve the functionality of the alternative over the lifecycle after deployment.

All quantifiable benefits were measured and separated into internal and external categories. Internal benefits are those that directly impact USDA. External benefits are those that do not directly impact USDA but benefit outside agencies or customers. Many of the benefits will result from labor savings due to improved processes. These savings are not to be interpreted as eliminating existing positions, but rather as a freeing up of resources to be allocated for more efficient uses towards meeting USDA objectives.

Evaluation of Future Technologies

The identification of the future technologies that could have a significant impact on GIAs over the next five to ten years was the next phase of the study. It was carried out by checking the literature on the internet and by interviewing acknowledged domain experts, including those in digital geospatial information, telecommunications, software engineering and computer science within the contractor's organization. The result was a list of eleven technologies that are expected to influence GIAs in the foreseeable future, although the exact weight of the influences is highly speculative.

Recommendation

The final phase of this study was the selection of the recommended geospatial information architecture solution from among the candidate alternative solutions. The selection was not a purely cost-benefit exercise. Rather, a number of intangible influences were considered, including the NRCS, FSA and RD internal cultures, the concerns of the Service Center Agencies' customer base, the probable funding options, legislative factors and the NRCS, FSA and RD political relationship with each other and with the USDA as a whole. The outcome was a "best solution" expected to provide an optimum combination of cost-benefit and technological solution that could be funded and implemented.

Geospatial Information Business Requirements

Background

The objective of this portion of the study was to identify and validate the business requirements of the three Service Center Agencies through a literature review and interviews with members of each agency and its partners. Business requirements were identified based on the activities that each agency is traditionally expected to provide and those which are mandated by legislation. The business requirements were determined through document reviews and interviews. Requirements are prone to change and it is possible that new business requirements may emerge from a shift in the emphasis or the focus of an agency, from new technologies, which provide new ways to conduct old activities, or from newly imposed legislation.

The initial step in conducting an assessment of new and future business requirements involved gaining an understanding of program objectives and identifying current business requirements. A significant number of (USDA) documents related to geospatial information were reviewed and analyzed. The documents provided were often in draft, suggesting that a final decision on the validity of the proposed course of action is still pending. Appendix H provides a bibliography of the documents referenced in this analysis. While the documents contained many descriptions of processes and numerous functional requirements, no document contained a definitive set of business requirements.

The interviews were conducted in order to validate the documented information related to business requirements. Participants from executive, scientific, and technical backgrounds and delegates from federal, state, and local levels were represented among the interviewees. Eighteen interviews consisted of representatives from the FSA, NRCS, and RD. Additional information was acquired from three interviews that involved members from the Information Technology Working Group (ITWG), the Conservation Districts (CD), and the Office of the Chief Information Officer (OCIO). Appendix A identifies the interview respondents. Appendix D contains the significant responses from the interviews.

The business requirements identified in the interviews were generally consistent with the business requirements identified in the documentation. Common requirements prevailed, regardless of agency affiliation or business mission. Most of the respondents were oriented to descriptions of functional requirements and missions rather than business requirements.

It is recognized throughout the documents that GIS and geospatial data are critical in the success of USDA. Currently, the processes that rely upon geospatial data to deliver services in the Service Centers often use manual cartography and map use technologies that are outmoded, prone to error and incredibly time consuming. GIS is expected to most directly benefit four USDA business areas: Farm and Community Programs, Eligibility and Compliance, Conservation, and Resource Inventory and Assessment. Through the use of GIS and shared geospatial data USDA expects to meet the requirements of Executive Order 12906, OMB Circular A-16, and the Electronic Freedom of Information Act (E-FOIA) amendments of 1996 as well as the Government Paper Work Elimination Act (GPEA) and Freedom to E-File Act.

It is also recognized that USDA has become the single largest Federal user of GIS technology and may soon have the largest number of GIS users in the Federal Government.

Missions and Business Requirements

An organization's business requirements are driven by its mission. According to the USDA Service Center GIS Strategy, NRCS, FSA, and RD conduct business differently to achieve their specific missions under the overall USDA mission. Periodic validation of these requirements is required to ensure that the Service Center Agencies are aligned with departmental and legislative direction.

Business Requirements Identified and Supported

The business requirements identified in the documentation and the interviews are presented in Table 0-1. The business requirements that are highlighted in gray coincide with those discussed in detail in Appendix F. The alternative GIA, which are described in detail in Section 5, are also shown. The business requirements are mapped against the alternative GIA with the benefit each business requirement will receive from a particular alternative GIA expressed as a percent. The percentages are assigned based on the knowledge of the various alternative GIA's capabilities.

Table 0-1: Business Requirements vs. Alternative Architectures With Benefits Expressed as a Percent

Service Center Agencies Business Requirements	Geospatial Information Architecture (GIA)			
	As-Is	To-Be Distributed	To-Be Mixed	To-Be Central
Conduct outreach and community relations	25%	75%	100%	75%
Provide customer and management with information	25%	75%	100%	75%
Process FOIA request	25%	75%	100%	80%
Conduct disaster assessment	25%	50%	100%	100%
Conduct and share natural resource inventories	75%	50%	100%	100%
Determine land eligibility	25%	100%	100%	75%
Determine acreage area	25%	100%	100%	100%
Determine cropping history	10%	75%	100%	100%
Determine environmental ranking	10%	100%	100%	75%
Conduct on site inspection	25%	100%	100%	25%
Determine applicable practices	25%	100%	100%	50%
Determine schedule of application	25%	75%	100%	25%
Review plan with customer	25%	100%	100%	25%
Process AD245	25%	100%	100%	100%
Provide AD862	25%	50%	100%	100%
Conduct review to ensure compliance	25%	100%	100%	100%
Perform status review	25%	100%	100%	100%
Support local and state conservation committees	25%	100%	100%	100%
Implement geospatial information training	10%	100%	100%	100%
Configuration manage, protect, monitor and report geospatial data status and integrity	50%	75%	100%	100%
Support integration of customer and program information across agencies and programs	10%	75%	100%	100%
Support integration of GPS and imagery (satellite to 35 mm digital slides) data into program processes	10%	100%	100%	25%
Support all applicable Federal information processing and geographic information standards, particularly those determined by the FGDC as supporting the NSDI	20%	50%	100%	100%
Support changing programmatic guidance, dataset requirements and system scale changes	25%	75%	100%	85%
Average All	25%	83%	100%	80%
Average Highlighted	23%	88%	100%	78%

Un-weighted average percentages are also shown for the total set of business requirements and those highlighted in gray. The averages show that the "As-Is" GIA is estimated to not support more than 25% of the business requirements while the "Mixed" GIA is estimated to support 100% of them. The "Distributed" and "Central" GIAs are estimated to support about 80% to 85% of the business requirements.

Organization of Functionality to Support Requirements

Not all Service Center Agencies require all of the enterprise GIS capabilities to meet their business goals. The GIS needs vary among agencies and office categories. Most of the USDA documents have indicated that the Service Center Agencies require simple interfaces that are designed to help efficiently manage geospatial data and deliver

quality products to USDA customers. Desktop GIS functionality, with the ability to print efficiently, has been a basic requirement. However, this is not sufficient to totally support agency program management.

USDA Enterprise GIS Needs for Service Center Agencies notes that multiple levels of enterprise GIS capabilities are needed among the Service Center Agencies. Such GIS requirements consist of Professional GIS, Desktop GIS, Web GIS, digitizing efforts, and GIS applications data server with a relational database management system (RDBMS).

- Professional GIS has a complete range of GIS functionality including complex spatial analysis functions, coordinate transformation capabilities, digitizing, map composition, map scanning, spatial query, and topology creation and maintenance.
- Desktop GIS has user-friendly map composition functions that allow data viewing tools with limited analytic functionality, data editing capability, and interactive digitizing.
- Web GIS has access to analytic functionality via the Internet.
- Digitizing tools transform hard copy map data to digital GIS data formats.
- GIS applications data server and RDBMS display functionality where data are stored as objects and in a relational database management system with spatial object extensions.

The GIS and geospatial data needed for the different offices vary with the office business requirements. Offices employing GIS technology at some level are identified as:

- Service Centers.
- State Offices.
- Digitizing Offices.
- Map Finishing Offices.
- Soil Survey Project Offices.
- Project Offices.
- Regional Offices.
- Centers and Institutes.
- National Headquarters.
- Development Centers.
- Web Server Farms.
- RC&D offices.

The complexity of the business requirements and the allocation of GIA functionality are seen in the examples below.

State offices require Professional GIS capabilities for GIS specialists who prepare state data sets and perform complex analysis. The NRCS state offices require enhanced functionality such as TIN, GRID, Mapplex, Image Analyst, Arc Press, ArcNetwork, and Geostatistical Analyst. The state office GIS personnel require Desktop GIS with extended features to perform wide area analysis for special projects. Spatial Analysis, 2D and 3D Analysis, Image analysis and Network Analysis, GIS applications data servers and RDBMS functionality are also required for NRCS state offices.

FSA state offices require basic Desktop GIS with enhanced printing (ArcPress) capability. FSA state office personnel require the ability to create and maintain GIS data layers and associated attributes. Database requirements for FSA include the ability to link to external tables and databases. Map/Cartographic/Report/Chart Tools are required for FSA state offices to create thematic maps of county and sub-county geographies for project management and project tracking. Similar functionality is required by NRCS.

The majority of Service Center Agency offices require a more limited desktop analysis capability that would be met through ArcView and customized extensions. However, NRCS and FSA personnel may require digitizing capability to capture local data. Analytical tools including query, intersection, buffering, overlay, proximity, (such as selecting all the CLU in a disaster area) may also be required. Tools that can display a wide variety of imagery formats such as MrSid compression, multi-spectral satellite, and DOQ could be required. History tracking and time-series data management including database versioning is critical for the maintenance of CLU. Image classification functionality can be necessary to classify flood zones, classify crops, and for image rectification.

Scaling the GIA selected to allocate functionality at the appropriate level will impact both the derived benefits and the costs incurred. Executing the system engineering to achieve this will be a serious challenge.

Other Requirements

Three other issues were addressed with varying frequency in documentation and by the interviewees:

- Customer Service Requirements.
- Data Requirements.
- Training Requirements.

All of these have implications for the successful implementation of any GIA, regardless of technical merits.

Customer Service Requirements

Customer surveys identified business requirements in the BPR Business Case that may be met, in some cases, by GIS and geospatial data. They are:

- Personalized, face-to-face service.
- Fewer and simpler regulations and forms.
- Knowledgeable staff.
- Staff members with positive attitudes.
- Flexibility in programs and local authority.
- Timely programs, information and service.
- Faster delivery of benefits.
- Accurate and timely status reports.
- Accessibility to local staff.
- Consistency.
- Follow-through.
- Privacy.

Data Requirements

An additional requirement that is not business requirement, but which is critical to meeting the business requirements was identified in the literature and the interviews. This is the Service Center Agencies' requirement to share common data themes in order to meet their business needs. According to the USDA Geodata Business Plan, 19 data layer themes have been recognized by the USDA community as necessary to successfully administer programs. As stated in several documents and verified in the interviews, there are four themes identified as critical; without them, GIS technology cannot be effectively used to create needed products. These are:

- Orthoimagery (aerial photography and satellite imagery used to inventory natural resources and administer programs).
- Common Land Unit (defines the critical relationship between the customer and the land and is used to link most business information to a unique geographic location).
- Soil Survey (county level digitized version of the National Cooperative Soil Survey (NCSS).
- Cultural and demographic data (data from the US Bureau of Census and Census of Agriculture).

The other 15 themes are less critical and often obtainable from other agencies. They are:

- Government Units and Place Names.
- Elevation.

- Hydrography.
- Cadastral (Public Land Survey).
- Transportation.
- Digital Raster Graphics (DRG).
- Land Cover/Vegetation.
- Watershed Boundaries (11-14 digit Hydrologic Units).
- Wetlands.
- Wetland and Floodplain Easements.
- Climate (Precipitation and Temperature).
- Flood Hazard Maps.
- USDA Office Information Profile (OIP).
- Applied Conservation Practices.
- Water Control Infrastructure/ National Inventory of Dams.

Although the three Service Center Agencies have indicated the need to share common data themes to perform in their business areas, due to a variety of scales and standards, lack of funding, and other factors, integration of data into a single regional coverage has been a challenge. According to the USDA Geodata Business Plan, core data layers have been identified so that all three agencies can establish partnerships and agreements both within USDA and with other federal, state and local agencies as well as academic institutions and private industry.

Training

Training is unique in that it is not directly traceable to any particular business requirement or legislation but is, nevertheless, considered a vital element to accomplishing any business requirement. Training was a prevalent theme that surfaced in every interview and was repeatedly emphasized as imperative.

The Service Center GIS Training Strategy for both pilot sites and full implementation was documented and verified in the interviews as effective and a relatively inexpensive GIS training method. GIS Software and Application training has been the focus for delivering GIS training to ensure Service Center Agencies with a standardized and comprehensive GIS training package. Recommendations within the training strategy entail the incorporation of GIS concepts and terms and GIS core and customized training.

During the interviews training was emphasized as urgent more often than any other requirement. It is regarded as a fundamental ingredient to successfully accomplishing business missions and managing customer demands. The requirements for training are based on the need to not only define business responsibilities but also to address and advocate tangible understanding of geospatial concepts and tools in order to best accomplish daily tasks. Knowing how to approach a task was viewed as essential to actually managing the task. Meeting business requirements and provision of quality training were seen by the interviewees as inextricably intertwined.

According to the interviewees, there was also an emphasis on the necessity to shift the focus from data gathering to data analysis. In order to achieve such aspirations, continual and focused training must be provided. However, many levels of awareness regarding relative technologies exists; therefore, training must be tailored to address the varying familiarity and learning curves associated with such geospatial information technology. With thoughtful and comprehensive planning regarding training strategies, greater satisfaction will inevitably be experienced by the staff and relayed to the customer.

Emerging Technologies Impacting Geospatial Information Architectures

This portion of the study identified emerging technologies that could impact GIAs over the next five to ten years. The result was a set of eleven technologies that are expected to influence GIAs in the foreseeable future. The exact weight of the influence is highly speculative and until formal and de facto standards emerge, these technologies may be difficult to incorporate into a real world production environment.

GIS should not only be viewed as a computer system that provides facilities for data capture, management, manipulation, and analysis, but as a technology. GIS technology innovations in the near future could affect how the USDA Service Center Agencies accomplish their business missions. These technologies could play an important role in the GIA decisions and deployments made by the three Service Center Agencies. They also provide an indication of the rapidity with which technological obsolescence can overcome what was a leading edge technology or deployment. The following discussion of emerging technological impacts is useful to understanding the GIAs as well as providing a context for the cost benefit analysis portion of the study.

Wireless Technology

Wireless technology has emerged rapidly and will allow consumers to surf the web, check email, download files, have real-time video conference calls, and perform a variety of other tasks through a wireless communication link.

Third generation wireless (3G) is capable of supporting high bandwidths. It involves high-speed Internet access, permanent "online" connection, secure mobile commerce, location-based services, personalized messages services, and audio and video streaming. 3G could bring a host of new applications onto the market. Virtual Private Network services can provide secure application-oriented architectures. Data storage management can be handled with ease utilizing a 3G wireless technology since the multi-application design of 3G will enable a fast and easy data deployment process.

Broadband wireless technology surpasses the telephone service in providing higher bandwidths and is a viable choice for rural areas. Compared to Digital Line Subscriber (DSL) systems and cable, implementation costs are less. It is rapidly deployable and scalable. Personal Digital Assistants (PDAs) are examples of wireless technology currently being deployed. Several standards are emerging for 3G, including Bluetooth, developed by Ericsson, IBM, Intel, Nokia and Toshiba, and the IEEE 802.11 standard that is a family of specifications developed by the IEEE for wireless Local Area Network (LAN).

The Web

Web based applications will increase as the technology continues to grow and change. Emerging technologies include XML (Extensible Markup Language) and Streaming Content.

XML is designed especially for Web documents allowing designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and organizations. As the Web browsers become more standardized, XML could replace the Hypertext Markup Language (HTML). XML shows great promise for the definition, exchange, and processing of structured information. Geospatial data such as metadata (information about the data) have been encoded in SGML, the parent form of XML. XML tools to process metadata should be beneficial for the GIS community.

XML can also be utilized to condense spatial information (primitives, features, and attributes) for streamed data exchange. Growth of the Internet has pushed streaming technologies to become increasingly important. Since most currently fielded computers do not have fast access to download large multimedia files quickly, streaming content can start displaying the data before the entire file has been transmitted. Some benefits include less re-buffering and overall higher quality connections.

“Near-Me” Technology

The concept of “Near-Me” Technology is that a hardware component includes the capability to determine its geospatial location (i.e. it has a GPS antenna or some other locating mechanism). In addition, the hardware has some sort of connectivity to the Internet, and if the connection is wireless then the device becomes extremely portable. Combining this hardware with smarter software designed to exploit the hardware capabilities opens up the door for some sophisticated applications.

Since the hardware knows where it is geospatially, the software can now take advantage of this knowledge to provide new services to the user. It can keep track of where it is as the user moves and can use its wireless connection to query remote servers to get information about the user's current environment (things that are "near-me"). The user needn’t explicitly request the information, as you would have to do with a web browser - it could automatically be pulled to the “near me” device as the user moves. Also, the software could automatically remove information that was no longer relevant to the user’s current location.

Voice and Handwriting Recognition

Computer systems that can recognize spoken words are currently available. A powerful computer with a voice recognition capability can recognize thousands of words. Due to high cost, voice recognition systems are used in a few specialized situations. Visually or physically handicapped persons can use this device when they cannot use the keyboard. As the cost decreases, and performance improves, voice recognition systems will enter the mainstream as an alternative to keyboards.

Handwriting recognition systems will also provide freedom from keyboards when this emerging technology becomes conventional. One of the key technologies currently employing handwriting recognition is found in PDAs and other hand-held devices. This technology is still immature and the user community may be slow in accepting it, due to the fact that most people can type faster than they can write.

Natural Language Processing

Natural Language Processing (NLP) is a branch of Artificial Intelligence. Currently, major universities are conducting research in NLP, speech synthesis, and robotics. Also known as 4GL, fourth-generation languages are closer to human languages than typical high-level programming languages such as C, C++, and JAVA. Although it is challenging to have computer systems understand natural languages, fourth-generation languages come closest to natural language.

Some of the applications in the computer system could be used for text critiquing, information retrieval, and database query. As the system matures, accuracy should greatly increase. In addition, human users can benefit by communicating with their computers in a natural way. NLP allows the handicapped to access the geospatial environment. NLP also allows development of public access mechanisms, such as information kiosks, which are accessible to the illiterate.

Handheld Device Convergence

Convergence is when two or more distinctive technologies come together, resulting in an integrated device that provides multiple capabilities or a new capability. For instance, the fax machine involved the convergence of telecommunications, optical scanning, and printing technology to provide the new capability of transmitting documents. Now, more sophisticated integrated devices such as combined pagers, cell phones, Global Positioning Systems (GPS), digital cameras, video cameras and computers, could all be provided on one wireless device.

Data Enrichment

A number of emerging technologies are providing for the enrichment of available geospatial data. Among these are the advent of commercial satellites providing higher resolution and multi-spectral imagery and the development of image processing/data extraction and classification software. Image processing software has some automatic feature extraction capabilities. For instance, software modules can perform land cover classification, feature extraction and image sharpening on digital imagery automatically. Work is underway to develop image segmentation (the ability to automatically identify meaningful regions in an image), feature finding, image similarity (identifying scenes that are similar in location), detection of a picture's main subject, and scene categorization.

Another technology is the advent of the digital camera. A digital camera allows images to be recorded and stored digitally rather than recording them on film, and once the picture has been taken, it can be downloaded to a computer system. Using a digital camera is cost effective since there is no film processing.

Light Detection and Ranging (LIDAR) is emerging as a data source for the future. Airborne LIDAR instruments shoot high-frequency laser pulses down to the ground and measure the time for the pulses to reflect back. Combining these distance measurements with Global Positioning System (GPS) data and measurements from Inertial Measurement Units (IMUs) enables the creation of very high resolution Digital Elevation Models (DEMs). These DEMs can range in resolution from 20 cm to 5 m and can possess a vertical accuracy of within 15 cm. Though the raw DEM data includes elevations from everything the laser hit, including trees and buildings, automated software exists to weed out these non-ground points and produce a true “bare earth” DEM. LIDAR is quickly replacing the traditional method of aerial photography to create DEMs. Not only are LIDAR DEMs much more accurate, but they are also cheaper than traditional DEM production.

Digital Signature and Encryption

A digital signature guarantees that an individual sending a message via the Internet is really who they claim to be. In electronic commerce, digital signatures are especially important and are a key component of most authentication schemes. The recipient of a digitally signed message can verify both that the message originated from the person whose signature is attached and that the message has not been altered either intentionally or accidentally since it was signed. Furthermore, secure digital signatures cannot be repudiated.

The National Institute of Standards and Technology (NIST) is taking a leadership role in the development of a federal Public Key Infrastructure (PKI) that supports digital signatures and other public key-enabled security services. NIST is currently concentrating on PKI architectures, security requirements for PKI components, and PKI-enabled applications.

Another form of security is through encryption. A very high standard of encryption derives from the Advanced Encryption Standard (AES). The AES will be the new Federal Information Processing Standard (FIPS) publication that will specify a cryptographic algorithm for use by U.S. Government organizations to protect sensitive (unclassified) information.

Adaptive Software

Adaptive software involves revolutionary or evolutionary software that can adapt to certain situations and modify or correct itself. Adaptive software can make adjustments automatically, devoid of user interface. A current example is adaptive software designed to help the visually handicapped individuals called “JAWS for Windows”. This is a software program designed to give blind computer users the ability to control their computer via audio feedback. This software can install its own software speech synthesizer that works with MS Windows and a 95/98/ME sound card without intervention.

Peer to Peer Communication

Peer to peer communication is a communications model in which each party has the same capabilities and either party can initiate a communication session. In some cases peer to peer communications is implemented by giving each communication mode both server and client capabilities. Users can choose how many member connections to seek at one time and determine which files they wish to share or password protect.

The advantages of using peer to peer communication is that employees can share files without the expense involved in maintaining a centralized server. This alternative to traditional distributed architecture may provide an avenue for linking Service Center Agency offices to share CLU and other data at a lower cost than a fully distributed database environment. The technology is currently being used by the Federal Government to share statistics and maps.

Terminal Server

Terminal Server software products, such as Citrix, provide distributed desktop functionality from a centralized, web-based architecture. The basic premise behind the terminal server architecture is that a relatively small bandwidth bitmap of the desktop application is transmitted over the network. In fact only the areas of the screen that are updated are transmitted as the static part of the interface does not require re-transmission. Examples of this technology applied to GIS exist both at ESRI and various ESRI customer sites, including the Maine Department of the Environment.

The terminal server requires three parts:

- The multi-user server core that provides the ability to host multiple, simultaneous client sessions.
- The remote desktop protocol that enables the desktop interface to be sent to the terminals by the server. The protocol is based on the International Telecommunications Union's T.120 protocol, an international, standard multi-channel conferencing protocol.
- The terminal server client that goes in each terminal.

The terminal server is not restricted to Windows, but can also accommodate UNIX, Macintosh and DOS systems that cannot be upgraded to 32-bit Windows.

Perceived drawbacks to this alternative include the lack of local printing capability and the lack of remote computing support. However, solutions are anticipated in the near term. A major drawback to this technology is its dependency on the availability of the network. However, it has no greater requirement than the network availability requirements of other centralized or WAN dependant technologies.

Geospatial Information Architectures

This section documents the postulated candidate architectures that could be deployed in the Service Center Agencies to meet the business and functional requirements for geospatial operations. There are four alternative architectures:

- Alternative 1 - Static Baseline With No New Acquisitions (As-Is).
- Alternative 2 – To-Be Distributed Alternative (Distributed).
- Alternative 3 – To-Be Centralized Alternative (Centralized).
- Alternative 4 – To-Be Mixed Alternative (Mixed).

Each alternative is described in terms of the impacts to software, hardware, network and human resources. A high level assessment is made for each alternative at the end of this chapter.

Alternative 1 - Static Baseline With No New Acquisitions

This section describes the "do nothing" alternative in which USDA does not invest any more in the Geospatial Information Architecture. This alternative is unlikely in practice, but serves as a baseline for the other architectures proposed in this study.

Assumptions

For this architecture alternative, it is assumed that the acquisition of GIS technology by all of the Service Center Agencies at every level is suspended and that no more investment in the technology will be made. It is recognized that this is an unrealistic direction for USDA even in the absence of an enterprise GIS agreement. However, this architecture serves as the "do nothing" baseline for which to compare other alternatives.

Characterization of Alternative

The extent of GIS throughout the enterprise is limited to the following:

- ArcView procured for the CST deployment for NRCS.
- ArcView procured for the CLU digitizing tool deployment , farm records maintenance tool, compliance tool, and acreage reporting prototype deployment for FSA..
- The varying number of copies of ArcView and ArcView extensions procured by individual counties, states and districts for a variety of piloting and special project use.
- The ESRI and a variety of other vendor software used by the GIS data production centers at APFO and NCGC.
- The ESRI application development software procured for the IT centers at NRCS ITC, FSA KCMO, FSA WDC and RD WDC.

Table 0-1 below details the ESRI software investment to date.

Table 0-1: ESRI Investment To Date

Agency	ArcInfo & Extensions	ArcView & Extensions	Internet Map Server	Spatial Data Eng.	Other
FSA	2	1267	2	4	8
NRCS	996	3104	19	3	37

In this scenario the "architecture" is an uncoordinated and disjointed collection of efforts to employ GIS technology for geographic analysis and business application development. There is a wide disparity between agencies, states and county offices in the number and capability of GIS technology. Organizations that have widespread

deployments do so through partnerships with other federal, state or local entities or through policy and legislative commitment. Except for the web-based efforts at ITC, NCGC and RD, the GIS data is stored locally in shape or other ESRI compatible formats (i.e. MrSID, GRID, etc.). Business application development is limited to ArcView Avenue for those sites that have the resources or are supported by IT organizations such as the case with the Customer Service Toolkit. NRCS has the choice of using CST or "out-of-the-box" tools for conducting geospatial business. However FSA is mandating the use of customized geospatial tools to assure nationally consistent data creation and maintenance. Customized products are more user-friendly and program focused which in turn cuts down training and support costs.

Alternative 2 – To-Be Distributed Alternative

This section describes an architecture that is made up of a federation of local service center databases and applications. It is meant to illustrate a purely distributed environment with very little emphasis on centralizing technology.

To-Be Distributed Alternative Assumptions

In this scenario, an enterprise purchase agreement is available to procure the full suite of GIS software. GIS products including desktop, professional, mobile and web based GIS systems as well as spatially enabled database middleware and embedded GIS tools. Since applications and data are distributed, it is assumed that the following infrastructure exists at the local Service Center:

- Server capable of hosting spatially enabled DBMS – The current CCE server configuration specifies two server platforms, the IBM AS/400 and the IBM Netfinity 5100. Each server configuration has alternative specifications depending on the size of the Service Center Office supported. See Table 0-2 and Table 0-3 for a detailed description of both platforms. The AS/400 was procured as a "safety net" for re-hosting FSA applications from frequently failing IBM A/36 machines. The AS/400 operating system, OS/400 Software Version V4R4, was selected primarily for compatibility to legacy applications. However, this version does not support most of the ESRI products including ArcSDE. Therefore, the only available "Server" class machine in the Service Center is the IBM Netfinity 5100 Server. Currently, CCE does not have a DBMS for the Netfinity server nor is procurement of such underway. It is imperative that a DBMS with spatial extensions is procured and deployed on Netfinity servers as soon as possible. Without this DBMS, the To-Be Distributed Alternative would not meet FSA business needs.

Table 0-2: CCE Netfinity Server Configuration

FY 00 – CCE100 Enterprise Domain Servers (A)	FY 00 – CCE101 Enterprise Domain Servers (B)	FY 00 – CCE102 External Storage Array
IBM Netfinity 5100 – Rack Mount Intel Pentium 933 MHz 256 L2 cache w/133MHz Bus 512 MB Memory expandable to 4 GB 2 – 9 GB Raid 1 Op Sys Ultra 3 Drives 3 – 36 GB Raid 5 Ultra 3 Drives Dual Channel Raid Controller w/64MB 40x IDE CD-ROM DLT 8000 40/80 GB Tape Backup 10/100 NIC w/IPSec MS WIN 2000 Server O/S 3 Year 4hr On-Site Warranty APC SU3000RM3U UPS – Rack Mount 10 Bay External Storage – option	IBM Netfinity 5100 – Rack Mount 2 - Intel Pentium 933 MHz 256 L2 cache w/133MHz Bus 1 GB Memory expandable to 4 GB 2 – 9 GB Raid 1 Op Sys Ultra 3 Drives 4 – 36 GB Raid 5 Ultra 3 Drives Dual Channel Raid Controller w/64MB 40x IDE CD-ROM DLT 8000 40/80 GB Tape Backup 10/100 NIC w/IPSec MS WIN 2000 Server O/S 3 Year 4hr On-Site Warranty APC SU3000RM3U UPS – Rack Mount 10 Bay External Storage – option	IBM EXT200 Storage Expansion Unit 10 bay storage chassis Rack mount Splitable backplane Supports 36.4 GB 10,000 RPM Ultra 160 SCSI HD Supports hot swappable HD

Table 0-3: CCE AS/400 Server Configurations

FY 00 - CCE111 **IBM Adv36 Replacements**	**FY 00 - CCE112** **IBM Adv36 Replacements**
IBM AS/400 Model 170 E-Server System Unit 2291 Model 170 Processor (256 MB) Base 8.0 GB Disk Unit 8.0 GB Disk Unit (Total Sys.: 16.0 GB) 4.0 GB ¼ inch Cartridge Tape PCI Base WAN/Twinaxial IOA PCI Base 100/10 Mbps Ethernet I/O PCI Cable V.24/EIA232 OS/400 Software Version V4R4 1 Year On-Site Warranty	IBM AS/400 Model 170 E-Server System 2291 Model 170 Processor (256 MB) Base 8.0 GB Disk Unit 8.0 GB Disk Unit (Total Sys.: 16.0 GB) 4.0 GB ¼ inch Cartridge Tape PCI Base WAN/Twinaxial IOA PCI 2-line WAN IOA PCI Base 100/10 Mbps Ethernet I/O PCI Cable V.24/EIA232 (Qty. 2) OS/400 Software Version V4R4 1 Year On-Site Warranty

- The Netfinity 5100 server is currently configured for a variety of tasks including email, print serving, remote administration, file serving, and network connectivity. The current software configuration is listed in Table 0-4. Other roles for the Netfinity server were modeled by the CCE Team, including GIS application and database hosting. However, GIS software and a DBMS are not included. The previous server models and ESRI minimum specifications indicate that the current Netfinity server would be adequate to support the full suite of ESRI client-server products. In addition, upgrades could be made to Netfinity platform that would increase the capacity to host distributed GIS applications. Therefore, it is feasible that the current Service Center Netfinity platform would satisfy the relatively small number of users and local datasets in the Service Centers. It is recommended that performance testing or benchmarks should be conducted to determine if the platform is capable of running all of the necessary local applications, spatially enabled or not, required by the Service Center Agencies.

Table 0-4: CCE Netfinity Software Configurations

IBM Netfinity 5100 with APC UPS.	
Software:	Windows 2000 O.S. Tivoli Server Management Software Lotus Domino 5.05 Enterprise Messaging System Software IBM NetDirector Executive Software Diskeeper

- Sufficient storage for local GIS layers – The BPR Projects provided estimates for sizing of the local storage required for background GIS data. Similar information could be extrapolated from the current GIS application efforts. A reasonable estimated range for database sizing at a local service center is four to twenty GB depending on the availability and resolution of data and the servicing area.

- Sufficient application environment for running customized GIS applications (e.g. NT, ASP) – FSA is currently moving towards JAVA as a standard development environment, whereas, NRCS has focused much of their recent GIS developments in VB/COM. ESRI clearly supports a richer API in VB/COM rather than JAVA.

- Trained local support staff capable of installing and maintaining GIS applications and databases. Deploying desktop applications and data to the local service center is within the realm of supporting most office applications. However, the operational support required of SDE is less trivial and may or may not be supported via remote administration tools.

Characterization of To-Be Distributed Alternative

In the purely distributed architecture, the Service Center GIS data and business applications are hosted locally to minimize the load on the Service Center WAN and to mitigate possible WAN downtime. Figure 0-1 shows the GIS data that is used for background display and analysis are stored locally either in native format (i.e. .tif, .shp, .sid) or as layer tables in a spatially enabled DBMS (e.g. SDE). These background data are delivered to the service center via CD-ROM or FTP from a variety of sources including USDA national data centers, NSDI clearinghouses, state, county and local agencies. GIS data used for critical business applications such as CLU, conservation plans, and crop reports are also stored locally in the spatial DBMS, which could be hosted on the Netfinity server. Legacy application data are currently being re-hosted from the A/36 to the AS/400 platform where they will eventually be re-engineered. In the interim, some of the legacy tabular data could be hosted on the AS/400 and synchronized with the spatial data elements on the Netfinity server.

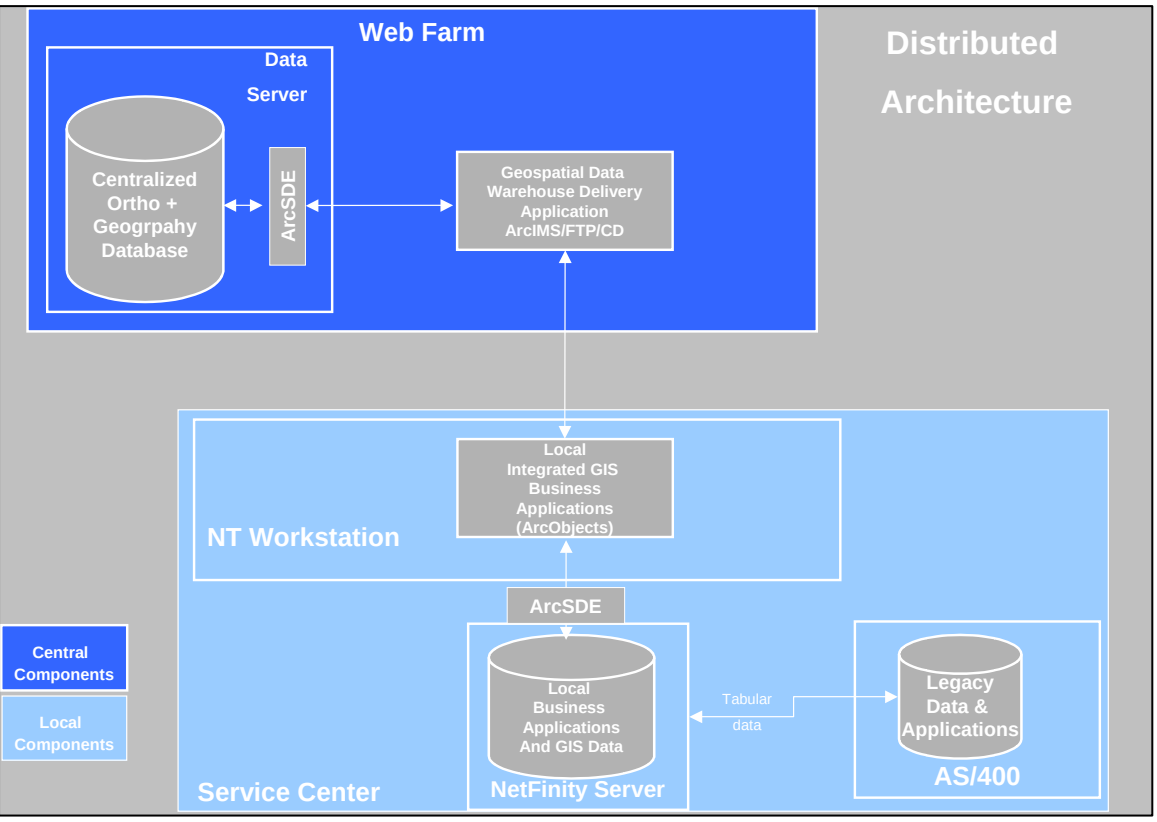


Figure 0-1: To-Be Distributed Alternative

Applications developed in this environment are hosted locally. ESRI has several options for providing GIS business functionally including ArcView, ArcEditor and ArcObjects. ArcView and ArcEditor are powerful, out-of-the-box applications that differ mainly in the type and sophistication of data they can process. ArcObjects provides a method to extend ArcView and ArcEditor to develop custom USDA applications that integrate the specific business needs of the Service Center. To meet the business requirements, applications would be developed centrally and distributed to the local clients or servers to run as integrated ArcObjects business applications using C++ and VB. Each deployable application of ArcEditor or ArcObjects

requires an ArcInfo license manager be present on the network. These applications would be developed and maintained by central IT staff and distributed by the Service Center Support Staff working locally or remotely. In a purely distributed environment, the Service Centers would not implement centralized data stores or centralized web applications.

To-Be Distributed Alternative Sizing

The following Table 0-5 is used as a guideline for sizing the enterprise environment for deploying the Geospatial Information Architecture in the Distributed Alternative.

Table 0-5: To-Be Distributed Alternative Sizing

ArcInfo GIS Suite	ArcView Suite	IMS Web Suite	Spatial Data Engine (SDE)	Handheld GIS and Location Service	Software Dev. and Deploy
265	25,735	0	39	5,165	138

Alternative 3 - To-Be Centralized Alternative

This section describes an architecture that is mainly supported by centrally or regionally co-located applications and database servers. This architecture is network and web technology intensive and provides little capability for locally distributed or remote processing.

Alternative Assumptions

In this scenario, an enterprise purchase agreement is available to procure the full suite of GIS software. GIS products include desktop, professional, mobile and web-based GIS systems as well as spatially enabled database middleware and embedded GIS tools. An emphasis is place on the procurement of centralized web-enabled GIS middleware and databases. Since applications and data are centralized, it is assumed that the following infrastructure exists.

- Both the AS/400 and the Netfinity server will be deployed as currently planned.
- WAN telecommunications capabilities will be upgraded to an average bandwidth equivalent to two T1 lines (three megabytes).
- Central and regional servers have been procured for the task of serving centralized business applications.

Characterization of To-Be Centralized Alternative

The Centralized Architecture is characterized by GIS business applications and data located on servers in a central or regional site. Each site would host a range of GIS business applications serving multiple local offices. Figure 0-2 illustrates the centralized alternative.

The current suite of ESRI GIS products does offer a web-based solution called ArcIMS. However, this product does not fulfill the full range of GIS functionality as required by the

Service Center Agencies. Of particular significance is the lack of editing capability offered by the current web based technology. Therefore, a purely centralized solution cannot fulfill 100% of Service Center business applications today.

A standard centralized server configuration has not yet been defined for the deployment of centralized business applications. FSA and NRCS are currently deploying NT based solutions running a variety of web server and DBMS products to support the Service Center Web Farms. Since this has not yet been completely defined, there is greater flexibility in the implementation of centralized applications.

In the case of GIS, a series of centralized data stores would be established to host GIS business applications. These data stores would use ArcSDE as the spatial data middleware interface to the data. A combination of ArcIMS and ArcInfo would be used as the application server middleware. ESRI offers a variety of APIs to their middleware software including VB, C++, JAVA, ColdFusion, ASP and JSP.

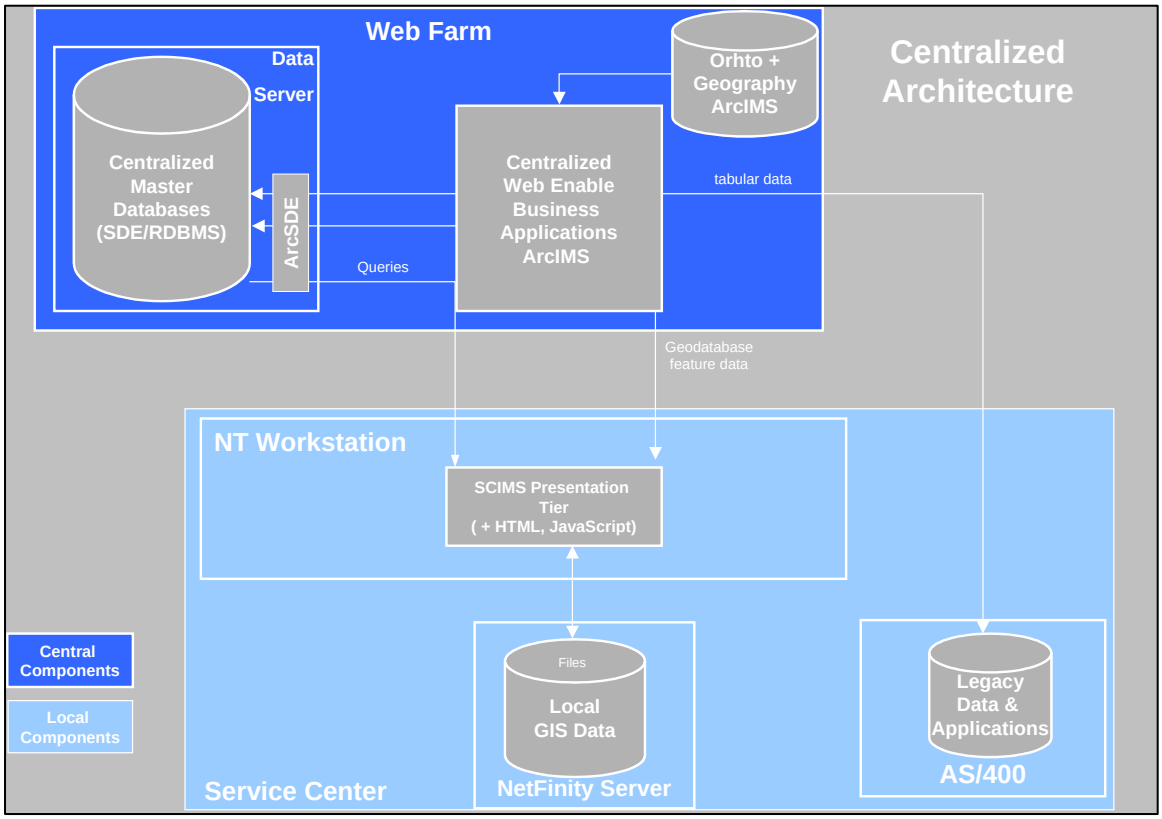


Figure 0-2: To-Be Centralized Alternative

To-Be Centralized Alternative Sizing

Table 0-6 is used as guidelines for sizing the enterprise environment for deploying the Geospatial Information Architecture in the To-Be Centralized Alternative.

Table 0-6: To-Be Centralized Alternative Sizing

ArcInfo GIS Suite	ArcView Suite	IMS Web Suite	Spatial Data Engine (SDE)	Handheld GIS and Location Service	Software Dev. and Deploy
265	25,735	108	39	5,165	138

Alternative 4 - To-Be Mixed Alternative

This alternative is a mixed distributed desktop and centralized web environment for the Geospatial Information Architecture. It employs the best of both approaches for better delivery of USDA programs internally and to their customers. This architecture aims to maximize the current investment in hardware, software, networks and human resources.

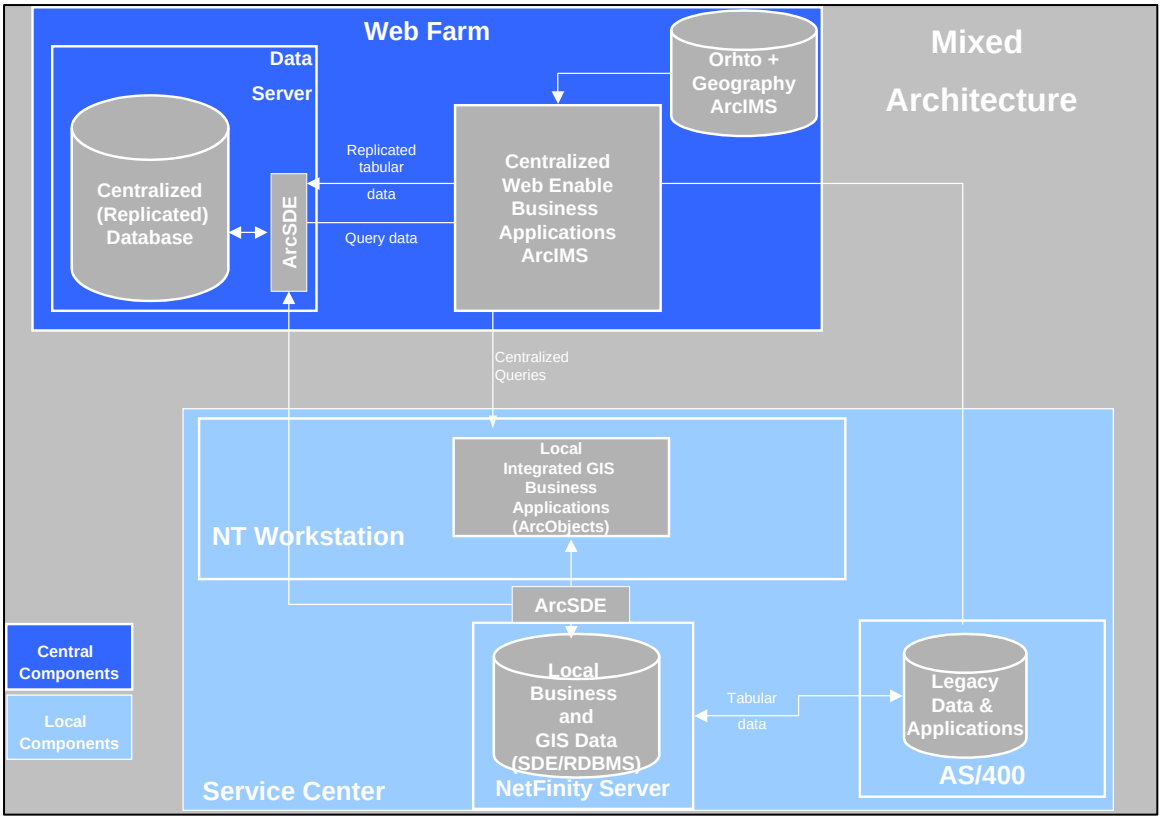
To-Be Mixed Alternative Assumptions

In this scenario, an enterprise purchase agreement is available to procure the full suite of GIS software. GIS products include desktop, professional, mobile and web based GIS systems as well as spatially enabled database middleware and embedded GIS tools. Applications are both distributed and centralized where most appropriate in an integrated system. Local Service Center hardware is capable of running locally distributed databases and applications. This implies that an RDBMS must be procured and deployed on the local NetFinity server. Centralized application servers must also be procured. Telecommunications must be enhanced to handle the load of centralized GIS applications. The cost benefit of each centralized application should be assessed on a case-by-case basis.

Characterization of To-Be Mixed Alternative

By analyzing each business application on a case-by-case basis, a determination can be made if it best suited for stand-alone, client server (LAN) or web based (WAN). The goal here is to maximize CPU usage and minimize WAN usage. In this scenario, only the editable GIS data are transmitted to the client application over the LAN/WAN. A smaller amount of browser graphics is transmitted via the WAN as relatively small image maps. In addition, local GIS data for background display and query are used by the local client, thus minimizing the bandwidth impact on the WAN. Figure 0-3 illustrates the mixed alternative.

As in the distributed alternative, any deployable application of ArcEditor or ArcObjects requires an ArcInfo license manager be present on the network. These applications would be developed and maintained by central IT staff and distributed by the Service Center Support Staff working locally or remotely.


Web Farm
Mixed
Architecture
Data
Server
Centralized
(Replicated)
Database
ArcSDE
Replicated
tabular
data
Query data
Centralized
Web Enable
Business
Applications
ArcIMS
Orhto +
Geography
ArcIMS
Centralized
Queries
Local
Integrated GIS
Business
Applications
(ArcObjects)
NT Workstation
ArcSDE
Local
Business
and
GIS Data
(SDE/RDBMS)
NetFinity Server
Tabular
data
Legacy
Data &
Applications
AS/400
Service Center
Central
Components
Local
Components

To-Be Mixed Alternative Sizing

Table 0-7 is used as a guideline for sizing the enterprise environment for deploying the Geospatial Information Architecture in the To-Be Mixed Alternative.

Table 0-7: To-Be Mixed Alternative Sizing

ArcInfo GIS Suite	ArcView Suite	IMS Web Suite	Spatial Data Engine (SDE)	Handheld GIS and Location Service	Software Dev. and Deploy
265	25,735	108	39	5,165	138

Architecture Alternative Assessment

This section illustrates in Table 0-8, an assessment of the four architectures in terms of pros and cons. This, coupled with the financial assessment of the architectures, will determine the recommendation put forth in the study.

Table 0-8: Pros and Cons of Each Architecture Alternative

Pros	**As-is**	**To-Be Distributed**	**To-Be Centralized**	**To-Be Mixed**
USDA has already made an investment in local servers.	✓	✓		✓
Much of the GIS business data will be created and updated locally	✓	✓		✓
Minimized the usage and dependency of the WAN	✓	✓		
Provides the richest and fasted set of GIS functionality to the local user, partners and customers		✓		✓
Provides ability to use local data	✓	✓		✓
User desktop speed it is not dependent on WAN load		✓		✓
Centralized Data Management and System Administration			✓	✓
Easier to aggregate data centrally			✓	✓
Supports access of transaction based GIS data outside Service Center Office			✓	✓
Centralized deployment of applications			✓	✓
Cons	**As-is**	**To-Be Distributed**	**To-Be Centralized**	**To-Be Mixed**
Maintaining a local GIS application and spatial database server is marginally more expensive and resource intensive than a purely centralized architecture.		✓		✓
In a purely distributed architecture data aggregation requires more work due to the inevitable differences between data coming from multiple counties (i.e. duplication of records, edge matching, gaps, etc.)		✓		
Deployment of distributed applications is marginally more costly than deployment of purely centralized applications. Central software distribution nodes or web based delivery mechanisms can lessen the cost of deployment, however, it will not eliminate the need for local intervention of the process.		✓		✓
Highly dependant on the bandwidth and availability of the WAN for performing daily business.			✓	
Rich GIS functionality not available. Does not empower employees to use COTS	✓		✓	
Speed at users desktop is variable depending on WAN load			✓	
Reduces the functionality and thus the benefits for Service Center Staff and Partners.	✓		✓	
Does not accommodate the need for local data from remote applications	✓		✓	
Does not support local applications			✓	

Costs

This section describes the costs involved in maintaining the current As-Is Baseline and the costs of the three To-Be Alternatives (purely Distributed, purely Centralized, and Mixed). The costs are projected over a 10-year lifecycle cost estimate (LCCE). As the report is not a budgetary document, the costs do not reflect actual budget allocations or constraints. The analysis represents the total 10-year cost of ownership of GIS. It presents the cost of the resources that would be allocated towards effectively implementing and maintaining each alternative. However, this does not mean that the costs are necessarily over and above current budget allocations. The funding for these resources may result in a request for increased funding, a reallocation of current resources, or could already be accounted for in current funding levels. Table 0-1presents the discounted 10-year LCCE for the baseline and the three alternatives.

Table 0-1: Discounted 10-year LCCE for the Baseline and Three Alternatives ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
As-Is Baseline	$147.1	$5.6	$5.5	$5.3	$5.1	$4.9	$4.8	$4.6	$4.5	$4.3	$4.2	**$195.9**
To-Be Distributed	$147.1	$54.4	$84.8	$79.8	$79.5	$81.0	$68.9	$56.7	$56.8	$53.7	$51.2	**$814.0**
To-Be Centralized	$147.1	$54.7	$105.4	$110.7	$118.3	$127.2	$122.0	$107.3	$105.8	$101.2	$97.2	**$1,196.9**
To-Be Mixed	$147.1	$62.1	$112.5	$114.3	$121.8	$130.6	$125.2	$110.5	$108.9	$104.2	$100.1	**$1,237.4**

As is clearly evident, GIS represents a significant investment. The To-Be Mixed Alternative has the highest cost because, to achieve full functionality, it is necessary to make investments that enable both a centralized and distributed solution. The main difference between the To-Be Distributed and To-Be Centralized alternatives results from the large telecommunications investment required to increase current bandwidth at each Service Center in order for centrally deployed data and applications to work effectively.

Cost Categories

The costs for the baseline and each alternative were made up of the following cost components:

Personnel Services: For the baseline, this comprises the personnel costs associated with maintaining the current system functionality. For each of the three alternatives, the personnel costs cover the cost for deploying and maintaining each alternative over the 10-year lifecycle. Personnel services includes GIS and IT specialists. GIS specialist will provide training on the use of GIS including software, data, and related items; support business leaders in training on applications; coordinate development, acquisition, delivery and maintenance of data themes including partnerships at the state and local level; and conduct GIS analysis in support of state and local programs. IT specialists will support software and hardware installation and maintenance for GIS tools, including GIS software, file allocation, system administration, printer and plotter support and maintenance, and network and other information systems needs.

Hardware: Contains all the hardware costs associated with each alternative or the baseline. Only those costs directly associated with GIS technology were included. These were either additional purchases or upgrades on available equipment. The types of investments made include application servers, network servers, high-end workstations, personal digital assistants (PDA), printers, and plotters. The cost for a Database Management System (DBMS) was not included since this investment would be made regardless of a GIS acquisition.

Software: Identifies the cost of purchasing ESRI GIS software based on a 5-year maintenance agreement.

Training: Includes the cost of training NRCS, FSA, RD, and Conservation District (CD) personnel to effectively use the GIS technology proposed and any customized ESRI applications, such as Customer Service Toolkit (CST).

Data: Covers the cost of the development of data including soils, orthoimagery, CLU, and compliance imagery for effective use of GIS technology.

New Development: Estimates the potential investments that NRCS, FSA, and RD will make in developing customized GIS applications such as the CST.

Telecommunications: Contains a percentage of the cost to upgrade the bandwidth at each Service Center to the equivalent of two T1 lines (three megabytes).

Miscellaneous: All other costs not otherwise included.

All costs are separated into non-recurring and recurring costs. The former incorporates all the costs involved in the full deployment and implementation of each alternative. Sunk costs were included as a non-recurring cost to show the approximate investment to date by the USDA in GIS technology. Recurring costs cover all expenses after the alternative has been implemented to maintain new system functionality or, for the baseline, the cost of maintaining current functionality.

A more detailed breakout on the costs for each alternative is provided in Appendix E.

A real 10-year discount rate of 3.2% was used in calculating all present value costs, as established by 2001 OMB Circular No. A-94. Discounting cash flows to the present enables decision-makers to evaluate alternatives on a common basis. The discount rate converts both benefits and costs occurring in future years to their equivalent current day value[1]. The more distant the costs, the smaller the present day value and vice versa.

As-Is Baseline Costs

The As-Is Baseline includes all the investments required to maintain current system functionality. No further investment will be made into providing GIS technologies to those Service Centers that do not currently have such capabilities. The purpose of this baseline is to demonstrate the full potential benefits of GIS. Using a baseline that includes additional investment in GIS would not clearly demonstrate the quantifiable GIS benefits to the USDA. Those Service Centers that have invested in some form of GIS technology will purchase annual software maintenance agreements to continue to maintain current functionality. Table 0-2 is a

[1] It is applied by using the following discount factor:

Where i is the discount rate and t is the year.

roll-up of the recurring and non-recurring estimated baseline 10-year LCCE including sunk costs.

Table 0-2: Total As-Is 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$15.3
Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Software	$9.0	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$37.9
Training	$7.7	$0.1	$0.2	$0.2	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$8.8
Data	$115.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$115.0
New Development	$6.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$6.0
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Misc.	$0.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$20.0
Total	**$147.1**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$203.1**
Discounted	**$147.1**	**$5.6**	**$5.5**	**$5.3**	**$5.1**	**$4.9**	**$4.8**	**$4.6**	**$4.5**	**$4.3**	**$4.2**	**$195.9**

Personnel costs cover the estimated cost of maintaining current GIS functionality. Software maintenance costs are based on current GSA ESRI schedule rates and current USDA ESRI software purchases. Training costs were included to cover the expense of continuing to train personnel at USDA facilities that currently have GIS. Miscellaneous costs cover the necessary expense to maintain and replace the current tools (planimeters, chains, etc) used by the USDA.

The baseline is difficult to accurately estimate due to the large number of uncertainties that would arise if no further investment in GIS were made. However, a baseline is needed when performing a CBA so as to better assess alternative solutions. In performing the analysis, many expressed that the baseline costs would likely be considerably higher. However, rather than running the risk of over inflating the baseline, thereby skewing the results even more towards a GIS investment, a conservative estimate of the baseline was used.

To-Be Distributed Alternative

The architecture for the To-Be Distributed Alternative is described in further detail in Section 5. The total 10-year LCCE, including sunk costs presented, is based on this architecture and shown in Table 0-3. These were estimated through a combination of existing USDA documentation, interviews with USDA personnel, and independent estimation based on USDA requirements.

Table 0-3: Total To-Be Distributed Alternative 10-year LCCE ($ millions)

	FY85 -00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$11.4	$13.0	$21.3	$19.7	$18.0	$18.0	$18.0	$18.0	$18.0	$18.0	**$182.7**
Hardware	$0.0	$18.3	$18.3	$9.3	$9.3	$9.3	$9.3	$9.3	$9.3	$9.3	$9.3	**$110.6**
Software	$9.0	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	**$45.5**
Training	$7.7	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$8.3	$10.6	$9.4	$8.3	**$89.3**
Data	$115.0	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$22.2	$22.2	$22.2	$22.2	**$404.9**
New Development	$6.0	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$7.8	$7.8	$7.3	$7.3	**$77.5**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$147.1**	**$54.4**	**$87.6**	**$85.0**	**$87.4**	**$91.9**	**$80.6**	**$68.5**	**$70.8**	**$69.1**	**$68.0**	**$910.4**
Discounted	**$147.1**	**$54.4**	**$84.8**	**$79.8**	**$79.5**	**$81.0**	**$68.9**	**$56.7**	**$56.8**	**$53.7**	**$51.2**	**$814.0**

The non-recurring costs are presented in Table 0-4. These represent the cost of implementing and deploying the To-Be Distributed Alternative. The non-recurring costs occur through FY06, when the system is expected to be fully operational and all the data development will be completed.

Table 0-4: Non-Recurring To-Be Distributed Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$11.4	$13.0	$21.3	$19.7	$18.0	$18.0	$0.0	$0.0	$0.0	$0.0	**$110.8**
Hardware	$0.0	$18.3	$18.3	$9.3	$9.3	$9.3	$9.3	$0.0	$0.0	$0.0	$0.0	**$73.6**
Software	$9.0	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$0.0	$0.0	$0.0	$0.0	**$33.5**
Training	$7.7	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$0.0	$0.0	$0.0	$0.0	**$52.6**
Data	$115.0	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$0.0	$0.0	$0.0	$0.0	**$316.1**
New Development	$6.0	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$0.0	$0.0	$0.0	$0.0	**$47.5**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$147.1**	**$54.4**	**$87.6**	**$85.0**	**$87.4**	**$91.9**	**$80.6**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$634.0**

The recurring costs for the To-Be Distributed Alternative are presented in Table 0-5. These represent the cost to maintain the new system functionality after it has been fully implemented, beginning in FY07.

Table 0-5: Recurring To-Be Distributed Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$18.0	$18.0	$18.0	$18.0	**$71.9**
Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$9.3	$9.3	$9.3	$9.3	**$37.0**
Software	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$3.0	$3.0	$3.0	$3.0	**$12.0**
Training	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$8.3	$10.6	$9.4	$8.3	**$36.7**
Data	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$22.2	$22.2	$22.2	$22.2	**$88.8**
New Development	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$7.8	$7.8	$7.3	$7.3	**$30.0**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$68.5**	**$70.8**	**$69.1**	**$68.0**	**$276.4**

Appendix E provides a more in-depth review of the cost associated with the To-Be Distributed alternative.

The personnel costs include both GIS and IT specialists. There are a total of 104 GIS specialists through FY02, increasing to 175 in FY03 for the remainder of the LCCE. The number of IT specialists ranges from 18 to 54, depending on the extent of implementation required in each year.

Hardware costs are based on the specifications identified in Section 5. They include the cost of one high-end workstation per Service Center, one high-end printer per Service Center, one plotter per Service Center, 5000 PDAs, and upgrading the application servers for GIS use. The initial purchase cost for these items was split over FY01 and FY02. Thereafter, a quarter of the total initial purchase cost was added per year to maintain a four-year refresh cycle on these hardware purchases. In addition, hardware for data repository was added based on 10% of the hardware costs for the on-line data warehousing of the To-Be Centralized Alternative.

The software costs are based on an anticipated five-year enterprise wide agreement with ESRI. Software maintenance costs are expected to remain relatively stable due to the purchasing power of the USDA. Without the enterprise wide agreement the software purchase and maintenance costs would be significantly higher. Section 6.6 describes in greater detail the potential cost savings from an enterprise wide agreement.

Training costs include training on ESRI tools and any customized applications developed. For NRCS, FSA, and RD, it was assumed that each of their employees would receive a three-day training class. This cost was split over two years. In the third year, each employee would receive a one-day training class. This cycle continues throughout the 10-year LCCE. For RD, it was assumed that half of their employees would receive a one-day training class per year. Appendix E provides a more detailed explanation and breakout on the training costs.

Data costs are based on estimates provided by the USDA for soils, orthoimagery, CLU, and compliance imagery.

The new development investment covers the anticipated investment FSA and NRCS will make in customizing ESRI GIS applications.

To-Be Centralized Alternative

The architecture behind the To-Be Centralized Alternative is described in further detail in Section 5. The total 10-year LCCE, including sunk costs, presented is based on this architecture and shown in Table 0-6. All costs for this alternative were estimated through a combination of existing USDA documentation, interviews with USDA personnel, and independent estimation based on USDA requirements.

Table 0-6: Total To-Be Centralized Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$10.8	$12.5	$20.8	$19.1	$17.4	$17.4	$17.4	$17.4	$17.4	$17.4	**$177.1**
Hardware	$0.0	$12.2	$12.7	$6.6	$6.7	$6.7	$6.8	$6.6	$6.6	$6.6	$6.6	**$77.9**
Software	$9.0	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	**$45.5**
Training	$7.7	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$8.3	$10.6	$9.4	$8.3	**$89.3**
Data	$115.0	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$22.2	$22.2	$22.2	$22.2	**$404.9**
New Development	$6.0	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$7.8	$7.8	$7.3	$7.3	**$77.5**
Telecomm	$0.0	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$64.3	$64.3	$64.3	$64.3	**$494.3**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$147.1**	**$54.7**	**$108.7**	**$117.9**	**$130.1**	**$144.3**	**$142.8**	**$129.6**	**$131.9**	**$130.2**	**$129.1**	**$1,366.3**
Discounted	**$147.1**	**$54.7**	**$105.4**	**$110.7**	**$118.3**	**$127.2**	**$122.0**	**$107.3**	**$105.8**	**$101.2**	**$97.2**	**$1,196.9**

The non-recurring investment for the To-Be Centralized Alternative is presented in Table 0-7.

Table 0-7: Non-Recurring To-Be Centralized Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$10.8	$12.5	$20.8	$19.1	$17.4	$17.4	$0.0	$0.0	$0.0	$0.0	**$107.4**
Hardware	$0.0	$12.2	$12.7	$6.6	$6.7	$6.7	$6.8	$0.0	$0.0	$0.0	$0.0	**$51.7**
Software	$9.0	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$0.0	$0.0	$0.0	$0.0	**$33.5**
Training	$7.7	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$0.0	$0.0	$0.0	$0.0	**$52.6**
Data	$115.0	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$0.0	$0.0	$0.0	$0.0	**$316.1**
New Development	$6.0	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$0.0	$0.0	$0.0	$0.0	**$47.5**
Telecomm	$0.0	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$0.0	$0.0	$0.0	$0.0	**$236.9**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$147.1**	**$54.7**	**$108.7**	**$117.9**	**$130.1**	**$144.3**	**$142.8**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$845.5**

The recurring costs for the To-Be Centralized Alternative are shown in Table 0-8.

Table 0-8: Recurring To-Be Centralized Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$17.4	$17.4	$17.4	$17.4	**$69.7**
Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$6.6	$6.6	$6.6	$6.6	**$26.2**
Software	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$3.0	$3.0	$3.0	$3.0	**$12.0**
Training	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$8.3	$10.6	$9.4	$8.3	**$36.7**
Data	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$22.2	$22.2	$22.2	$22.2	**$88.8**
New Development	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$7.8	$7.8	$7.3	$7.3	**$30.0**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$64.3	$64.3	$64.3	$64.3	**$257.4**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$129.6**	**$131.9**	**$130.2**	**$129.1**	**$520.8**

Appendix E provides a more in-depth review of the cost associated with the To-Be Centralized alternative.

The personnel costs include both GIS and IT specialists. There are a total of 104 GIS specialists through FY02, increasing to 175 in FY03 for the remainder of the LCCE. The number of IT specialists ranges from 12 to 54, depending on the extent of implementation required in each year. Fewer IT specialists will be required than in the To-Be Distributed Alternative as all data and applications will be deployed from a central location.

Hardware costs are based on the specifications identified in Section 5. They include the cost of one high-end workstation per Service Center, one high-end printer per Service Center, one plotter per Service Center, 5000 PDAs, and upgrading network servers for GIS use. The initial purchase cost for these items was split over FY01 and FY02. Thereafter, a quarter of the total initial purchase cost was added per year to maintain a four-year refresh cycle on these hardware purchases. No upgrades to local application servers were estimated since all GIS applications will be centralized. In addition, hardware costs for an on-line data warehouse/data mart were included. The initial purchase cost of this system was spread out through FY06 based on the anticipated implementation schedule identified in Table 0-2. A four-year refresh cycle on these hardware purchases was also included in the LCCE.

For a centralized alternative to fully function, an increase in current bandwidth at each Service Center is required. This infrastructure investment would not solely occur due to GIS, but GIS is the main driver behind the need to increase bandwidth. Hence, 50% of the estimated cost to increase bandwidth was allotted to the 10-year LCCE of this alternative. The costs are based on the information provided in the Modernizing Telecommunications for

USDA Offices in New Mexico: A Blueprint for Action and assumes an average bandwidth equivalent of two T1 lines (three megabytes) per Service Center. The installation costs, equipment costs, and monthly charge for service are an average of the costs charged by five different vendors.

Software, training, data, and new development costs are the same as in the To-Be Distributed Alternative.

To-Be Mixed Alternative

The architecture for the To-Be Mixed Alternative is described in further detail in Section 5. Table 0-9 shows the 10-year LCCE including sunk costs based on this architecture. A more detailed review of the costs is provided in Appendix E.

Table 0-9: Total To-Be Mixed Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$11.1	$12.8	$21.0	$19.4	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7	**$179.9**
Hardware	$0.0	$19.3	$19.8	$10.1	$10.2	$10.3	$10.4	$10.1	$10.1	$10.1	$10.1	**$120.7**
Software	$9.0	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	**$45.5**
Training	$7.7	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$8.3	$10.6	$9.4	$8.3	**$89.3**
Data	$115.0	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$22.2	$22.2	$22.2	$22.2	**$404.9**
New Development	$6.0	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$7.8	$7.8	$7.3	$7.3	**$77.5**
Telecomm	$0.0	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$64.3	$64.3	$64.3	$64.3	**$494.3**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$147.1**	**$62.1**	**$116.1**	**$121.7**	**$133.9**	**$148.2**	**$146.6**	**$133.4**	**$135.7**	**$134.0**	**$132.9**	**$1,411.9**
Discounted	**$147.1**	**$62.1**	**$112.5**	**$114.3**	**$121.8**	**$130.6**	**$125.2**	**$110.5**	**$108.9**	**$104.2**	**$100.1**	**$1,237.4**

The non-recurring investment for the To-Be Mixed Alternative is presented in Table 0-10.

Table 0-10: Non-Recurring To-Be Mixed Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$9.5	$11.1	$12.8	$21.0	$19.4	$17.7	$17.7	$0.0	$0.0	$0.0	$0.0	**$109.1**
Hardware	$0.0	$19.3	$19.8	$10.1	$10.2	$10.3	$10.4	$0.0	$0.0	$0.0	$0.0	**$80.2**
Software	$9.0	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$0.0	$0.0	$0.0	$0.0	**$33.5**
Training	$7.7	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$0.0	$0.0	$0.0	$0.0	**$52.6**
Data	$115.0	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$0.0	$0.0	$0.0	$0.0	**$316.1**
New Development	$6.0	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$0.0	$0.0	$0.0	$0.0	**$47.5**
Telecomm	$0.0	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$0.0	$0.0	$0.0	$0.0	**$236.9**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$147.1**	**$62.1**	**$116.1**	**$121.7**	**$133.9**	**$148.2**	**$146.6**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$875.7**

The recurring costs for the To-Be Mixed Alternative are shown in Table 0-11.

Table 0-11: Recurring To-Be Mixed Alternative 10-year LCCE ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$17.7	$17.7	$17.7	$17.7	**$70.8**
Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$10.1	$10.1	$10.1	$10.1	**$40.5**
Software	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$3.0	$3.0	$3.0	$3.0	**$12.0**
Training	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$8.3	$10.6	$9.4	$8.3	**$36.7**
Data	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$22.2	$22.2	$22.2	$22.2	**$88.8**
New Development	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$7.8	$7.8	$7.3	$7.3	**$30.0**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$64.3	$64.3	$64.3	$64.3	**$257.4**
Misc.	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$133.4**	**$135.7**	**$134.0**	**$132.9**	**$536.2**

Appendix E provides a more in-depth review of the cost associated with the To-Be Mixed Alternative.

The personnel costs include both GIS and IT specialists. There are a total of 104 GIS specialists through FY02, increasing to 175 in FY03 for the remainder of the LCCE. The number of IT specialists ranges from 15 to 54, depending on the extent of implementation required in each year. Fewer IT specialist will be required than in the To-Be Distributed Alternative as most data and applications will be deployed from a central location. As this alternative is a mix, the number of IT specialists required is higher than the purely centralized alternative.

Hardware costs are based on the specifications identified in Section 5. They include the cost of one high-end workstation per Service Center, one high-end printer per Service Center, one plotter per Service Center, 5000 PDAs, and upgrading application and network servers for GIS use. The initial purchase cost for these items was split over FY01 and FY02. Thereafter, a quarter of the total initial purchase cost was added per year to maintain a four-year refresh cycle on these hardware purchases. The upgrades to local application servers identified in the To-Be Distributed Alternative were included since both centralized and distributed capabilities exist. In addition, hardware costs for an on-line data warehouse/data mart were included. The initial purchase cost of this system was spread over out through FY06 based on the anticipated implementation schedule identified in Table 0-2. A four-year refresh cycle on these hardware purchases was also included in the LCCE.

An increase in current bandwidth at each Service Center is also required for the To-Be Mixed Alternative. As with the To-Be Centralized Alternative, 50% of the estimated cost to increase bandwidth was allotted to the 10-year LCCE. The costs are based on the information provided in the Modernizing Telecommunications for USDA Offices in New Mexico: A Blueprint for Action. Costs assume an average bandwidth equivalent to two T1 lines (three megabytes). The installation costs, equipment costs, and monthly charge for service are an average of the costs charged by five different vendors. As the same level of data transfer is anticipated, the costs are the same as in the To-Be Centralized Alternative.

Software, training, data, and new development costs are the same as in the To-Be Distributed Alternative.

Enterprise Wide Solution Versus Incremental Purchases

This section demonstrates the financial savings of having an enterprise wide software agreement with ESRI versus NRCS, FSA, and RD purchasing the software on their own accord off the GSA schedule. Table 0-12 lists the anticipated number of software licenses each agency would need and the current costs of purchasing the software and maintenance agreements. The number of licenses needed would depend on the To-Be Alternative chosen but it represents a conservative estimate of the potential number required.

Table 0-12: Purchase and Maintenance Cost of ESRI Tools at Current GSA Schedule Rates

Software	No. of Licenses	Initial Purchase Cost	Initial Purchase Total	Yearly Maintenance Cost	Yearly Maintenance Total	Comments
Arc SDE	2700	$8,111	$21,899,700	$3,900	$10,530,000	1 per Service Center
Arc View	26743	$1,069	$28,583,246	$381	$10,193,346	Estimated number of field GIS users
Arc GIS (Editor)	7000	$7,403	$51,821,000	$2,168	$15,176,000	Estimated 1 user per 4 Arc View users
Arc View Extensions	5400	$2,342	$12,646,800	$619	$3,342,600	2 per Service Center
Arc Pad	5000	$405	$2,025,000	$307	$1,535,000	
ARC IMS	108	$6,136	$662,688	$1,316	$142,128	
Total			**$117,638,434**		**$40,919,074**	

* Weighted average of the Unix and Windows versions of Arc View.

Although no final enterprise wide agreement with ESRI has been reached, the 5-year estimate for purchase and maintenance of $21.5 million for the ESRI applications used in each To-Be Alternative is conservative. Hence, as shown, the potential savings from the enterprise wide agreement are enormous.

Benefits

This section describes the benefits derived from the implementation of GIS technology at the USDA. The benefits are broken down into three categories:

- Internal Benefits that accrue directly to the USDA.
- External Benefits that apply to the USDA's customers.
- Non-quantifiable Benefits, which are real benefits that accrue to USDA and its customers that are not easily translated into monetary values or that cannot be quantified with a sufficient level of accuracy.

The benefits were estimated over a 10-year lifecycle beginning in FY01. Benefits do not begin accruing until at least a portion of the system is deployed. The baseline and each of the three alternatives have a different level of benefits that is directly correlated to the level of GIS functionality available in each scenario. Table 0-1 presents the 10-year discounted benefits stream for the baseline and the three alternatives. It is a compilation of internal (NRCS, FSA, RD, and CD) and external benefits.

Table 0-1: Discounted 10-year Benefits for the Baseline and Three Alternatives ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
As-Is Baseline	$2.1	$8.2	$10.9	$13.4	$15.8	$18.0	$17.5	$16.9	$16.4	$15.9	**$135.1**
To-Be Distributed	$21.1	$81.9	$109.1	$134.4	$158.0	$180.1	$174.6	$169.1	$163.9	$158.8	**$1,351.2**
To-Be Centralized	$18.1	$70.2	$93.4	$115.0	$135.2	$154.2	$149.4	$144.8	$140.3	$135.9	**$1,156.5**
To-Be Mixed	$24.1	$93.4	$124.3	$153.2	$180.1	$205.3	$199.0	$192.8	$186.8	$181.0	**$1,540.0**

As is clearly seen, the To-Be Mixed Alternative has the greatest benefits since it provides the USDA with the greatest functionality.

Calculating Benefits

The benefits were calculated using information provided by the USDA. This included existing reports and interview information. Each document was reviewed and updated accordingly to reflect more current staffing levels. The majority of benefits resulted from labor savings. The labor benefits should not be interpreted as eliminating existing positions, but rather as a freeing up of resources to be allocated for more efficient use towards meeting other existing and newly mandated USDA objectives.

Internal benefits accrue from NRCS, FSA, CD, and RD process improvements. Internal benefits for NRCS and RD were originally estimated from the USDA Service Center Business Process Reengineering Business Case. CD benefits were estimated based on the NRCS benefits[2]. The benefits were validated through independent assessment and interviews with USDA personnel. The benefits were adjusted to reflect current staffing levels and costs. Additional benefits outside the report were included where applicable.

FSA benefits were primarily calculated based on the Farm Service Agency GIS Business Case and the APFO Strategy for a Changing Environment. Both were validated through independent assessment and interviews with USDA personnel. The benefits were adjusted to reflect current staffing levels and costs. Additional applicable benefits outside the report were included where applicable.

The aforementioned reports were used to determine the maximum total potential yearly internal benefits of each agency. In each report, the maximum total potential yearly internal benefits were a collection of various functions performed by agency personnel that would change if GIS tools were implemented. Each of the components that was

[2] Sufficient information was not available to make a comprehensive estimate of the internal benefits accrued by CD. However, based on the similarity of business functions performed by CD and NRCS, it was determined that basing CD benefits on documented NRCS benefits would provide a reasonable estimate.

part of the maximum total potential yearly internal benefits was reviewed to determine how the benefits would be affected if a particular architecture was deployed. It was assumed that the To-Be Mixed Alternative would provide full functionality and therefore receive 100% of the maximum total potential yearly internal benefits. For the To-Be Distributed and Centralized Alternatives, each component was assessed to determine the factor that would be used to estimate the internal benefits associated with that alternative. Appendix F provides the various factors that were used to determine the different benefits between alternatives.

External benefits were estimated through use of existing USDA documentation and interview responses. These were validated and updated to reflect current market conditions.

In addition to the system functionality, the level of benefits generated each year is based on the deployment of the alternative. The deployment level is constant across all three alternatives. It is affected by both the ability to integrate the technology across the USDA and the speed at which the data development occurs. Through interviews with USDA personnel, an appropriate deployment factor was determined and is presented in Table 0-2.

Table 0-2: Deployment Factor

FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
10%	40%	55%	70%	85%	100%	100%	100%	100%	100%

The deployment factor is multiplied by the total potential yearly benefits of each alternative to estimate the 10-year benefit stream.

A real 10-year discount rate of 3.2% was used in calculating all present value benefits, as established by 2001 OMB Circular No. A-94. Discounting cash flows to the present enables decision-makers to evaluate alternatives on a common basis. The discount rate converts both benefits and costs occurring in future years to their equivalent current day value. The more distant the benefits, the smaller the present day value and vice versa.

As-Is Baseline Benefits

Although the baseline assumes no further investments into GIS, the GIS investments made to date still generate benefits for the USDA. These benefits were estimated based on the current level of licenses of ESRI tools versus overall potential demand, equating to approximately 10%. This factor was then applied to the benefits derived by the To-Be Distributed Alternative. Table 0-3 presents the benefits associated with the As-Is Baseline.

Table 0-3: As-Is Baseline 10-year Benefits ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
NRCS	$0.0	$0.7	$2.6	$3.6	$4.6	$5.6	$6.6	$6.6	$6.6	$6.6	$6.6	**$49.9**
FSA	$0.0	$0.8	$3.2	$4.4	$5.6	$6.8	$8.0	$8.0	$8.0	$8.0	$8.0	**$60.5**
RD	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	**$0.6**
CD		$0.5	$1.9	$2.6	$3.3	$4.1	$4.8	$4.8	$4.8	$4.8	$4.8	**$36.4**
External	$0.0	$0.2	$0.7	$0.9	$1.2	$1.5	$1.7	$1.7	$1.7	$1.7	$1.7	**$13.0**
Total	**$0.0**	**$2.1**	**$8.5**	**$11.6**	**$14.8**	**$17.9**	**$21.1**	**$21.1**	**$21.1**	**$21.1**	**$21.1**	**$160.3**
Discounted	**$0.0**	**$2.1**	**$8.2**	**$10.9**	**$13.4**	**$15.8**	**$18.0**	**$17.5**	**$16.9**	**$16.4**	**$15.9**	**$135.1**

To-Be Alternatives

As mentioned above, the benefits for each of the To-Be Alternatives (Distributed, Centralized, and Mixed) were estimated from existing reports and interview information. Appendix F provides the detailed breakout of how the benefits were estimated by agency. The following tables (Table 0-4, Table 0-5 and Table 0-6) present the benefits generated by each To-Be Alternative.

Table 0-4: To-Be Distributed Alternative 10-year Benefits ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
NRCS	$0.0	$6.6	$26.2	$36.1	$45.9	$55.8	$65.6	$65.6	$65.6	$65.6	$65.6	**$498.7**
FSA	$0.0	$8.0	$32.0	$43.9	$55.8	$67.6	$79.5	$79.5	$79.5	$79.5	$79.5	**$605.0**
RD	$0.0	$0.1	$0.3	$0.4	$0.6	$0.7	$0.8	$0.8	$0.8	$0.8	$0.8	**$6.1**
CD	$0.0	$4.8	$19.1	$26.3	$33.5	$40.7	$47.8	$47.8	$47.8	$47.8	$47.8	**$363.6**
External	$0.0	$1.7	$6.8	$9.4	$12.0	$14.5	$17.1	$17.1	$17.1	$17.1	$17.1	**$129.8**
Total	**$0.0**	**$21.1**	**$84.6**	**$116.1**	**$147.7**	**$179.2**	**$210.9**	**$210.9**	**$210.9**	**$210.9**	**$210.9**	**$1,603.2**
Discounted	**$0.0**	**$21.1**	**$81.9**	**$109.1**	**$134.4**	**$158.0**	**$180.1**	**$174.6**	**$169.1**	**$163.9**	**$158.8**	**$1,351.2**

Table 0-5: To-Be Centralized Alternative 10-year Benefits ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
NRCS	$0.0	$4.8	$19.3	$26.5	$33.7	$41.0	$48.2	$48.2	$48.2	$48.2	$48.2	**$366.4**
FSA	$0.0	$8.0	$32.0	$43.9	$55.8	$67.6	$79.5	$79.5	$79.5	$79.5	$79.5	**$605.0**
RD	$0.0	$0.1	$0.2	$0.3	$0.4	$0.4	$0.5	$0.5	$0.5	$0.5	$0.5	**$3.8**
CD	$0.0	$3.5	$14.1	$19.3	$24.6	$29.9	$35.1	$35.1	$35.1	$35.1	$35.1	**$267.1**
External	$0.0	$1.7	$6.8	$9.4	$12.0	$14.5	$17.1	$17.1	$17.1	$17.1	$17.1	**$129.8**
Total	**$0.0**	**$18.1**	**$72.4**	**$99.4**	**$126.4**	**$153.4**	**$180.5**	**$180.5**	**$180.5**	**$180.5**	**$180.5**	**$1,372.2**
Discounted	**$0.0**	**$18.1**	**$70.2**	**$93.4**	**$115.0**	**$135.2**	**$154.2**	**$149.4**	**$144.8**	**$140.3**	**$135.9**	**$1,156.5**

Table 0-6: To-Be Mixed Alternative 10-year Benefits ($ millions)

	FY85-00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
NRCS	$0.0	$7.8	$31.2	$42.9	$54.6	$66.3	$78.0	$78.0	$78.0	$78.0	$78.0	**$593.1**
FSA	$0.0	$8.8	$35.2	$48.3	$61.3	$74.3	$87.4	$87.4	$87.4	$87.4	$87.4	**$665.1**
RD	$0.0	$0.1	$0.4	$0.5	$0.6	$0.8	$0.9	$0.9	$0.9	$0.9	$0.9	**$6.9**
CD	$0.0	$5.7	$22.8	$31.3	$39.8	$48.4	$56.9	$56.9	$56.9	$56.9	$56.9	**$432.5**
External	$0.0	$1.7	$6.8	$9.4	$12.0	$14.5	$17.1	$17.1	$17.1	$17.1	$17.1	**$129.8**
Total	**$0.0**	**$24.1**	**$96.4**	**$132.4**	**$168.4**	**$204.3**	**$240.4**	**$240.4**	**$240.4**	**$240.4**	**$240.4**	**$1,827.3**
Discounted	**$0.0**	**$24.1**	**$93.4**	**$124.3**	**$153.2**	**$180.1**	**$205.3**	**$199.0**	**$192.8**	**$186.8**	**$181.0**	**$1,540.0**

As the To-Be Mixed Alternative provides full functionality, it has the greatest benefits. The To-Be Distributed Alternative provides the second greatest level of functionality and, hence, the second highest level of benefits.

Non-Quantifiable Benefits

Non-quantifiable benefits are benefits that are realized but cannot be quantified due to the qualitative nature of the benefit or the lack of available data to make a sufficiently accurate estimation. For example, quality of life and improved employee morale cannot be quantified with a high enough level of confidence to be included in any calculations. Nevertheless, these benefits can be an extremely significant factor in an investment decision.

GIS provides several benefits that accrue to both the USDA and its customers but are difficult to assess quantitatively. Following is a list of some of the qualitative benefits of GIS:

- Ability to use geospatial information to make informed business decisions.
- Faster access to more current and accurate geospatial information.
- Improved map quality and access to a common base map.
- Elimination of redundant work and data, resulting in reduced Service Center workload.
- Accurate data development.
- Efficient analysis tool.
- User-friendly querying techniques.

The following examples were taken from the interviews to illustrate these benefits:

- FSA is currently piloting an annual ortho-rectified digital imagery program to be used in the compliance process. This data layer would be used in place of the analog 35mm slides currently used for this process. A product would provide a significant benefit to other local and state government in need of high resolution, ortho-rectified imagery. The fact that it is digital make is more accessible and useful. This, in turn, may stimulate cost-sharing opportunities that could reduce the cost of this layer to USDA.

- One of the water districts in Oregon described a situation where they used GIS to gather hydrologic and soils data from several surrounding districts to conduct a runoff analysis for a large watershed in the northwest. GIS technology not only made the job easier, but they claim that they could not have done the job at all without it. Many of these benefits will never be realized until the technology is in the hands of the Service Center employees.

- Twenty-one new programs were implemented at FSA this past year. Much of the data collected from these programs is distributed throughout local offices in mostly tabular format. The policies and procedures set in one state may (adversely) affect what happens in a bordering state. A good example is the Conservation Reserve Program being implemented by FSA and NRCS. Using a GIS, USDA could assess the overall effectiveness of the CRP program and lend more scientific insight to the legislative decision process. In other words, technology may help organize thoughts more efficiently so that more comprehensive decisions can be drawn.

- All of the agencies rely on outreach as a public relations tool. One of the biggest barriers to outreach is the lack of information about the underserved. Policy and program implementation could benefit greatly from the collective demographic and program analysis provided through a GIS.

- Academia and the USDA have a long history of partnership. However, academic institutions cannot always get the data need to perform agricultural research. By making agricultural GIS data available, universities can conduct research that may result in better USDA program delivery.

- Conservation Districts are another important partner of the USDA Service Center Agencies. By enabling the over 7000 district employees with GIS technology, the USDA will benefit greatly from their support in the field in terms of data products, analysis, public relations and congressional support.

- Many producers throughout the US are investing in geospatial technology such as GPS and many have Internet connectivity as well. GIS provides a new way for the Service Center employees to communicate with customers, which, in turn, will boost the public perception of doing business with USDA. This type of communication will help to educate the producers and thus reduce that amount of support requested from USDA.

Financial Risk Analysis

This section discusses the risk and sensitivity analysis that was done on both cost and benefit projections, using a risk assessment software called Crystal Ball. Over a 10-year lifecycle, there is uncertainty and risk with cost and benefit calculations. SAIC identified those areas where this was of particular concern. These areas cover various cost components of each proposed alternative and potential benefits.

Risk and uncertainty are a fact of life for all decision makers. Understanding the risk/reward trade-off throughout the development lifecycle helps to ensure that scarce resources are directed towards the best possible uses and that realistic financial plans can be developed.

At the heart of this effort is forecasting (i.e., costs and benefits). Forecasting is necessary because all organizations operate in an atmosphere of uncertainty and, despite this fact, decisions must be made that affect the future of that organization. Forecasting should supplement the common sense of management and take into account both quantitative and qualitative forecasting techniques to avoid total reliance on either. Systematically incorporating risk and uncertainty into the forecasting process is essential to realistically assess the potential costs and benefits of full implementation of any of the proposed alternatives.

The modeling and risk analysis approach presented in this section combines both quantitative and qualitative techniques to develop cost and benefit forecasts. The approach provides a range of possible outcomes, as well as the probability of occurrence.

Monte Carlo Simulation

Most real world problems that involve elements of uncertainty and variability (e.g., benefit forecasts) are too complex to be solved by strict analytical methods such as linear extrapolation from historical data. These analytic techniques only result in single-point estimates, which do not indicate the likelihood of achieving any particular outcome.

Investigating uncertainty and variability of model inputs and outputs through sensitivity or high-low analysis is inadequate to accurately capture the true relationship between variables. In these types of analyses, essential variables are manipulated individually and independently. This problem is particularly acute when variables are correlated (i.e., the value of one variable is dependent on the value of another such as the price of gasoline and the price of oil).

These techniques are also inadequate when dealing with large complex problems where an unforeseen combination of values may yield an unanticipated result. In addition, there are usually too many possible combinations of input values to calculate every possible answer, yet insight about the range of possible outcomes is critical information for stakeholders.

The underlying uncertainty and variability in model inputs can be systematically addressed through a risk analysis technique called Monte Carlo simulation. Rather than developing a single estimate for an input, a probability distribution describes the uncertainty and variability of the data. This allows the entire range of possible outcomes to be calculated as well as the likelihood of achieving them. This provides decision makers with a more robust and informative analysis, providing greater confidence in the ultimate decisions.

Establishing Probability Distributions

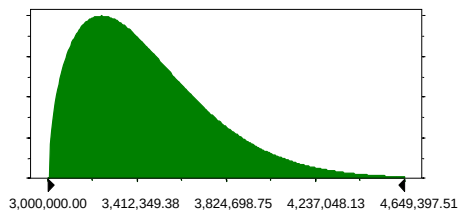
Probability distributions and values are usually assigned to all factors that effect potential costs or benefits. In the absence of historical data, the choice of distribution is made on reasoned judgment and expert opinion. Types of probability distributions include: normal distributions, lognormal distributions, and Weibull distributions. Establishing appropriate distributions and values is based on quantitatively and qualitatively assessing a number of factors including:

- The underlying uncertainty of an input’s value.

- The variability of an input's value.
- The robustness of the historical data.
- The institutional and other barriers.

For example, it was determined that the software maintenance costs for the ESRI tools after the initial 5-year agreement could have a significant impact on the LCCEs. To assess the impact on the LCCEs if the costs did change, a Weibull probability distribution was used with a minimum cost of $3 million. The probability distribution was positively skewed to reflect the likelihood that the price would probably not exceed $4 million. This resulted in Figure 0-1.

Figure 0-1: Weibull Probability Distribution of Software Maintenance Costs in Out Years



Calculating Results

A financial model is a series of calculations based on different input values used to obtain an end result. In the USDA CBA, probability distributions were assigned to many of these input values. Once appropriate probability distributions are selected, a Monte Carlo simulation can be run. During a Monte Carlo simulation, each probability distribution is sampled and a unique value is obtained. Since the input values are the basis for other results, as the input values change, so do all the other numbers that are affected by this value. The simulation trial concludes when all the equations are solved and the results are calculated. The number of times the simulation is repeated depends on the number of trials selected (2,500 trials were conducted for this analysis). After repeated samplings, a probability distribution for each result metric is generated.

A number of values are generated for each model result, such as the mean, the standard deviation, the median value, and the range minimum and maximum. The mean value will differ from the median value when the probability distributions of the model inputs are skewed (non-normal distributions). This occurs because the mean value is the average of all the simulation trials while the median is the value exactly half way between the range minimum and maximum.

A probability density function is defined by meeting two requirements: $0 \le p_i \le 1$, and $\sum p_i = 1$, where i = the number of trials in the simulation. The probability density function for a result is derived from the results of a simulation.

Each simulation trial ends with a value being calculated for each result metric.

Associated with this result is a probability value that is defined as $p_i = \frac{1.0}{i}$. As results are calculated, they are sorted into bins or numeric intervals with the probability associated with that result adding to the probabilities of the other results that fell in the bin. Bins are defined as an equal part of a numerical range that is determined from the range of results calculated.

After a simulation is complete, the resulting graph of all the bins will resemble the graph in Figure 0-2. This graph does not represent actual results for this study and is only used here for demonstration purposes. This graph presents the 99% confidence distribution of a sample analysis.

Figure 0-2: Sample Frequency Distribution

As seen in the graph, a bin is shown as a rectangular bar. The higher the bin, the more likely that value will occur. The ***probability*** axis represents the percentage of results that fell within a particular bin. The ***frequency*** axis represents the actual number of results that fell within a particular bin.

The ***trials*** represent the number of times the simulation is run. In this case, the simulation ran 2,500 times.

Crystal Ball forecasts the entire range possible for a result based on all of its associated probability functions. However, any value outside a 99% confidence distribution is denoted as an ***outlier*** on the chart. Outliers represent the extreme values that occurred during the forecasting of the result. For this simulation, 17 outliers existed.

For Figure 0-2, one can interpret with 99% confidence that the final result for this distribution will fall within $411 million and $432 million. This allows a program manager to determine whether or not the results meet the agency criteria for making an investment decision. For example, assume that the graph represents the cost of building a new data warehouse. If the agency has appropriated over $431 million in funding, the program manager can be relatively confident that the data warehouse costs will not exceed the program budget. However, if the agency has only secured $425 million, the program manger will need to determine if he is willing to go forth with the program since the budget lies within the 99% confidence distribution.

Financial Results

This section provides a summary of the financial results of the analysis conducted. The CBA results support the investment in GIS for all three alternatives. However, the case is much stronger for the To-Be Distributed and To-Be Mixed Alternatives.

The net present value (NPV) measures the difference between discounted benefits and discounted costs as compared to the baseline. An NPV above zero indicates a worthwhile investment. In this analysis, all three had a positive NPV.

The benefit-cost ratio (BCR) is calculated by dividing the benefits by the costs. Values greater than one indicate a worthy investment. The BCR for all three alternatives is greater than one.

The internal rate of return (IRR) calculates the discount rate at which NPV equals zero; that is, the rate at which the present value of benefits equals the present value of costs. Any rate above the discount rate used indicates a worthwhile investment. All three alternatives had an IRR that exceeded the OMB discount rate.

The payback year represents the year in which the sum of the benefits is greater than the sum of the costs. All three alternatives have a payback year that occurs within the 10-year LCCE.

Table 0-1 summarizes the risk-adjusted CBA results without non-quantifiable benefits. When non-quantifiable benefits are considered, the case in favor of GIS only becomes more convincing. Typically, investment decisions are based upon NPV results while the IRR, BCR, and payback year provide insight into an investment's value. The point estimate represents the value has calculated by the financial model. The risk adjusted mean value represents the mean value of the distribution that results from the Crystal Ball analysis described in Section 8.

Table 0-1: Discounted Cost and Benefit of Each Alternative

	Point Estimate	Risk Adjusted Mean Value
Baseline LCCE (PV $M)	$195.9	$195.9
Distributed LCCE (PV $M)	$814.0	$815.7
Centralized LCCE (PV $M)	$1,196.9	$1,199.3
Mixed LCCE (PV $M)	$1,237.4	$1,239.8
Baseline Benefits (PV $M)	$135.1	$135.1
Distributed Benefits (PV $M)	$1,351.2	$1,351.1
Centralized Benefits (PV $M)	$1,156.5	$1,156.4
Mixed Benefits (PV $M)	$1,540.0	$1,539.9

Table 0-2 summarizes the NPV, BCR, IRR, and payback year of each alternative compared to the As-Is Baseline.

Table 0-2: CBA Results Compared to the As-Is Baseline, including Sunk Costs

Alternative	Baseline NPV vs. Alternative – Point Estimate (PV $M)	Baseline NPV vs. Alternative – Risk Adjusted Mean Value (PV $M)	BCR – Point Estimate (PV $M)	BCR – Risk Adjusted Mean Value (PV $M)	IRR	Payback Year
To-Be Distributed	$597.9	$596.1	1.97	1.96	86%	2004
Centralized	$20.3	$17.8	1.02	1.02	6%	2010
Mixed	$363.4	$360.8	1.35	1.35	49%	2005

As is clearly indicated from the above tables, an investment in GIS technology using any of the alternatives will benefit the USDA. Figure 0-1, Figure 0-2 and Figure 9-3 show the minimum and maximum range of the NPV for

each alternative, at 99% confidence. As the Crystal Ball results indicate, the NPV for the To-Be Distributed and To-Be Mixed Alternatives always remains positive. For the To-Be Centralized Alternative, there is only a 73.4% probability that it will have a positive NPV.

Figure 0-1: To-Be Distributed NPV (PV $M)

Figure 0-2: To-Be Centralized NPV (PV $M)

Figure 9-3: To-Be Mixed NPV (PV $M)

Figure 0-4 combines the NPVs of all three alternatives. As shown, the To-Be Distributed Alternative has a greater quantifiable benefit than the other two alternatives. Moreover, the difference between the upper and lower boundaries for the To- Be Distributed Alternative is much narrower than for the other two alternatives. This is largely due to the additional risk inherent in any centralized solution. The main risk factor in the To- Be Centralized and To-Be Mixed Alternatives arises from the telecomm costs.

Figure 0-4: Overlay Chart of To-Be Alternatives' NPVs

The NPV results for each alternative support a decision to invest in GIS. However, the To-Be Centralized Alternative presents the greatest risk with only a 73.4% certainty that the NPV will be above zero and has the smallest NPV. The To-Be Mixed Alternative provides the greatest quantifiable benefits but due to the large telecomm costs, the resulting NPV is lower than the To-Be Distributed Alternative.

Recommendations

Best Cost/Benefit Solution

Based on the cost-benefit analysis the investment in either the To-Be Distributed or To-Be Mixed Alternatives will greatly benefit the service center agencies. However, the monetary benefit of the To-Be Distributed Alternative is superior.

Best Technical Solution

The To-Be Mixed Alternative is the technically superior solution as it allows selective exploitation of the advantages found in both the To-Be Distributed and Central Alternatives. It also supports all of the business requirements for the same reason. Based on the technical evaluations of the Forest Service (USFS), which has a centralized architecture and is migrating to a decentralized architecture, the To-Be Distributed Alternative is desirable. However, the To-Be Distributed Alternative does not meet all of the business requirements and has issues involving system maintenance, data aggregation and applications deployment.

Best Organizational Solution

The current situation is that the government is proceeding with the purchase and deployment in the near term of a To-Be Distributed Alternative. This alternative is proceeding based on CCE architecture decisions to meet the need for email, file services, etc. and are not being driven by GIS. However, based on this study, the To-Be Distributed Alternative is also the best organizational solution. This would seem to make the other alternatives, at least temporarily, moot.

Recommended Solution

The As-Is Alternative is not an acceptable solution. It supports only 25% of the business requirements. It also has a negative cost benefit relationship as it costs about $60 million more than it returns and it has a number of technical weaknesses.

Table 0-1 summarizes the financial, technical and organizational rankings of the three “To-Be” alternatives. The To-Be Centralized Alternative is consistently the third choice. The To-Be Distributed Alternative is clearly the best choice financially and organizationally. It ranks second technically as it does not support all of the business requirements and has a worse ratio of pros to cons than the To-Be Mixed Alternative. However, its financial results, the organizational realities and its strong showing in the technical areas make the To-Be Distributed Alternative the recommended choice.

Table 0-1: Status of “To-Be” Alternative GIA Solutions

	Net Present Value Risk Adjusted	Benefit Cost Ratio	Internal Rate of Return	Payback Year	Pros and Cons	Requirements Supported	Organizational Solution	Recommended Solution
To-Be Distributed Alternative	$596 M Best	1.97 Best	86% Best	2004 Best	6 to 3 Second	85% Second	Best	Best
To Be Centralized Alternative	$18 M Third	1.02 Third	6% Third	2010 Third	4 to 6 Third	80% Third	Third	Third
To-Be Mixed Alternative	$361 M Second	1.35 Second	49% Second	2005 Second	9 to 2 Best	100% Best	Second	Second

Appendix A: Interviewees

NAME EMAIL	BIO	AGENCY	TITLE	PHONE NUMBER	INTERVIEW DATE	COMMENTS
Alvin, Katie katie.alvin@mt.usda.gov	Y	NACD	Natural Resource Planner	406-522-4016	12-Apr	
Anderson, Dave dandersom@itc.nrcs.usda.gov	N	NRCS	Technical and Engineering Services and Data Management Team Leader	970-295-5539	12-Apr	Service Center Initiative
Armstrong, Chuck chuck.armstrong@vt.usda.gov	Y	NACD	District Program Coordinator and Crop Consultant	802-296-1662 X12	13-Apr	Written interview question response
Bethel, Glen glenn.bethel@usda.gov	N	FSA	Chief of Remote Sensing Section	202-720-1280	5-Apr 11-Apr	Remote Sensing
Gardner, Bill bill.gardner@usda.gov	N	OCIO	Senior Policy Advisor for Service Center Implementation	202-720-3482	23-Apr	Political
Boyles, Mike emboyles@kcc.usda.gov	N	FSA - KCMO	Chief, CSSB, PSCAD, KC-ITSDO	816-926-1905	17-Apr	
Brinkman, Dennis dennis.brinkman@ks.nrcs.usda.gov	Y	NRCS	District Conservationist	785-267-0073	12-Apr	Written interview question response
Bruner, Gary	N	NRCS	District Conservationist	■	9-Apr	
Bryant, Sandy sandy_bryant@wdc.fsa.usda.gov	Y	FSA	Branch Chief, Common Provisions Branch	202-720-4380	5-Apr	
Buckles, Scott sbuckles@xit.net	Y	NACD	Board Member	806-769-4464	12-Apr	
Carlson, Jack	N	NRCS	Director, ITC	970-296-5455	12-Apr	
Clarke, Christine christine.clarke@usda.gov	N	NRCS	Geodata Coordinator	301-504-2267	2-Apr	NRCS POC
Coleman, Stephen steve.coleman@mail.state.ky.us	Y	NACD	Director	502-564-3080	13-Apr	
Cook, Elizabeth elizabeth.cook@mo.usda.gov	N	NRCS	GIS Specialist	573-876-9396	18-Apr	
Corwine, Idonna idonna.corwine@ks.usda.gov	Y	FSA	Program Technician	785-828-4631 or 785-828-3666	N/A	Written interview question response
Cosgrove, Bill bill.cosgrove@usda.gov	N	NFAC	Director for the Program Management Office	202-720-8650	23-Apr	
Croman, William bill.croman@fl.usda.gov	Y	FSA	Farm Loan Manager	863-763-3345 X501	11-Apr	
Crook, Bryan bryan.crook@tx.usda.gov	Y	FSA	Agricultural Program Specialist	979-680-5155	6-Apr	
Davis, Rebecca rebecca_davis@wdc.fsa.usda.gov	Y	FSA	Chief Compliance Branch	202-720-9882	5-Apr	
Davis, Rich rich.davis@usda.gov	N	RD	Director of Program Support Staff	202-720-9649	19-Apr	
Deal, Glendon	N	RD	Senior Engineer	202-720-1582	19-Apr	
Eckblad, Steve seckblad@itc.nrcs.usda.gov	N	NRCS	Project Manager	970-295-5553	12-Apr	
Ernst, Carol carol.ernst@usda.gov	Y	FSA	Program Specialist	202-720-7634	5-Apr	

NAME EMAIL	BIO	AGENCY	TITLE	PHONE NUMBER	INTERVIEW DATE	COMMENTS
Gabbott, Geoff ggabbott@apfo.usda.gov	Y	APFO	Contracting Officer for the APFO	801-975-3500 X207	9-Apr	
Gaskill, Rebecka rjgaskill@kcc.fsa.usda.gov	Y	FSA - KCMO	Chief, FRB, PARMD, KC-ITSDO	816-926-1645	17-Apr	
Gaston, Linda lgaston@rdmail.rural.usda.gov	Y	RD	Chief, Operations Research and Systems Development	202-720-0653	13-Apr	
Golden, Mike michael.golden@tx.usda.gov	Y	NRCS	MLRA Region 9 Leader and State Soil Scientist	254-742-9851	19-Apr	
Gordon, Chuck cgordon@mt.usda.gov	N	NRCS	State Soil Scientist and MO leader	406-587-6818	19-Apr	
Green, Kathy kathy.green@mo.usda.gov	Y	NRCS	Resource Conservationist and GIS	573-446-9091	18-Apr	Training techniques and cost factors
Gross, Tonye tonye.gross@usda.gov	Y	FSA	Branch Chief, Peanut Branch, Tobacco and Peanuts Division	202-720-4319	11-Apr	Written interview question response
Hall, Rosemary rnhall@kcc.usda.gov	Y	FSA - KCMO	Chief, PARMD, KC-ITSDO	816-926-1975	17-Apr	
Hall, Shirley shirley.hall@nfac.usda.gov	N	FSA	Agriculture Program Specialist, PECD	202-720-3138	5 April	PECD GIS Coordinator
Hansen, Kim	N	NACD	Conservation District Employee	■	12-Apr	
Heald, Jim jim_heald@wdc.fsa.usda.gov	Y	FSA	GIS Computer Specialist	202-720-0787	11-Apr	CLU Technical Support and Tool Development
Hill, Baxter baxter.hill@rdmail.rural.usda.gov	Y	RD	Architect and Chief, Technical Support Branch	202-720-1499	13-Apr	
Hockert, Dan dan.hockert@mn.usda.gov	Y	FSA	Chief Specialist for Compliance	651-602-7706	6-Apr	CLU
Holman, Dwight	N	NRCS	NRCS Regional Conservationist	202-720-6297	6-Apr	NRCS Business Management
Holy, Doug doug.holy@usda.gov	N	NRCS	Team Leader - Service Center And Interagency Support Team	301-504-2238	N/A	COTR
Hopkins, Guy guy-hopkins@or.nacdnet.org	Y	NACD	District Planner	541-278-8049 X104	12-Apr	
Huber, Karl khuber@dcr.state.va.us	Y	NACD	GIS / Database Manager	804-371-7484	13-Apr	
Huslig, John jhuslig@rus.usda.gov	Y	RD	Financial Analyst	202-690-3594	19-Apr	
Jett, Carole carole.jett@usda.gov	N	NRCS	Associate Deputy Chief for Programs	202-720-6580	9-Apr	
Jones, Misty misty_jones@wdc.fsa.usda.gov	Y	FSA	Agricultural Program Specialist	202-720-0200	11-Apr	
LaFlamme, Brian blaflamm@rdmail.rural.usda.gov	Y	RD	Environmental Scientist	202-720-9656	13-Apr	RD POC
Linsenbigler, Mile mike.linsenbigler@usda.gov	N	FSA	Program Specialist	202-720-6303	11-Apr	
Lowenfish, Martin martin_lowenfish@wdc.fsa.usda.gov	Y	FSA	Environmental Protection Specialist	202-720-3264	11-Apr	
Lubich, Kennith	Y	NRCS	National Soil Survey Digitizing and Digital Map Finishing Coordinator	608-276-8732 X248	N/A	Written interview question response

NAME EMAIL	BIO	AGENCY	TITLE	PHONE NUMBER	INTERVIEW DATE	COMMENTS
Lund, Daryl daryl.lund@usda.gov	Y	NRCS	Program Analyst and Soil Scientist, Resources Inventory Division	301-504-2278	2-Apr	
Lytle, Dennis dennis.lytle@usda.gov	Y	NRCS ITWG	GIS Team Leader	301-504-4150	23-Apr	
Mathew, Helen helen_mathew@wdc.fsa.usda.gov	Y	FSA	Program Specialist	202-720-9878	5-Apr	
Mausbach, Maurice maurice.mausbach@usda.gov	Y	NRCS	Deputy Chief - Soil Survey and Resource Assessment	202-690-4616	9-Apr	Soil Survey
McCoy, Nicole nicole-mccoy@wa.nacdnet.org	N	NACD	GIS Specialist	509-925-8585	12-Apr 13-Apr	NACD and questionnaire
McKay, David david.mckay@usda.gov	Y	NRCS	Resource Conservationist	202-720-1835	23-Apr	Customer Tool Kit
Murphey, Bill bill.marphey@md.usda.gov	N	FSA	Community Development Manager	410-632-0939	9-Apr	
Newcomer, John john_newcomer@wdc.fsa.usda.gov	Y	FSA	Program Specialist	202-720-6157	5-Apr	
Nicholls, Ronald rnicholls@apfo.usda.gov	Y	FSA - APFO	Director of the APFO	801-975-3500 X205	9-Apr	
Niedermayer, Chris chris_niedermayer@wdc.usda.gov	Y	FSA	Assistant to the Deputy Administrator, Farm Programs	202-720-6635	9-Apr	APFO
Oaks, Wendell woaks@itc.nrcs.usda.gov	N	NRCS	Project Manager	970-295-5479	12-Apr	
Paglia, Judy judy.paglia@nfac.usda.gov	Y	FSA	Agriculture Program Specialist	301-504-4116	5-Apr	
Parham, Tommie tparham@ftw.nrcs.usda.gov	Y	NRCS	Director and NCGC Branch Chiefs	817-509-3420	5-Apr	Written interview question response
Patterson, Jerry jgpatterson@kcc.fsa.usda.gov	Y	FSA - KCMO	Director, KC-ITSDO	816-926-6698	17-Apr	
Peters, Bruce bruce_perters@wdc.usda.gov	Y	FSA	Senior Loan Specialist, FSA/DAFLP/PDEED	202-720-7003	11-Apr	
Plank, Mark	Y	RD	Senior Environmental Scientist	202-720-1649	19-Apr	
Reid, Norman nreid@rurdev.usda.gov	Y	RD	Acting Associate Deputy Administrator RD	202-260-6332	19-Apr	
Rismiller, Steve steve-rismiller@oh.nacdnet.org	Y	NACD	District Technician	513-732-8880	13-Apr	
Rohaley, George	N	NRCS	National Remote Sensing Leader, Resources Inventory Division	301-504-2268	2-Apr	
Scurry, Jim	N	NACD	■	■	13-Apr	
Sharp, Diane dsharp@wdc.fsa.usda.gov	Y	FSA	Acting Deputy Administrator for Farm Program	202-720-7641	5-Apr	
Sheaver, Michael	N	NACD	■	■	12-Apr	
Sims, Reed reed.sims@vt.usda.gov	Y	NRCS	GIS Specialist	802-951-6796 X243	19-Apr	
Stainbrook, Sue sue.stainbrook@kspaola.fsc.usda.gov	Y	RD	Community Development Specialist	913-294-3751 X4	9-Apr	
Stickels, George	N	FSA	■	■	11-Apr	

NAME EMAIL	BIO	AGENCY	TITLE	PHONE NUMBER	INTERVIEW DATE	COMMENTS
Stieger, Lee lrsteiger@kcc.usda.gov	N	FSA - KCMO	Computer Specialist	816-926-2104	17-Apr	
Sundseth, Dan dan.sundseth@or.usda.gov	Y	FSA	County Executive Director	541-967-5925 X107	6-Apr	New Digitizing Center
Thomas, Mary	N	NRCS	■	■	N/A	Chief Information Officer
Tidyman, Carla carla.tidyman@nfac.usda.gov	N	FSA	■	301-504-4120	11-Apr	FSA POC
Tuttle, Chris ctuttle@usda.gov	Y	RD	Economist	202-205-3655	19-Apr	
Wall, Michael	Y	NRCS	Resource Conservationist	■	N/A	Written interview question response
Wilbrant, Scott scott.wilbrant@ks.usda.gov	N	FSA	State Specialist for Kansas	785-539-6988	6-Apr	CLU
Williamson, Dennis dennis.williamson@tx.usda.gov	Y	NRCS	State GIS Specialist	254-742-9830	19-Apr	
Wood, Jim jwood@agri.state.id.us	Y	NRCS NACD	NRCS Idaho One Plan Liaison and Water Quality Specialist	208-332-8592	12-Apr	Idaho One Plan

Appendix B: Frequently Asked Questions

Who is the COTR for this effort?
Doug Holy. E-mail: Doug.Holy@usda.goc and telephone 301-504-2241.

Who are the interviewers?
Two groups within Science Applications International Corporation (SAIC) are involved with this project: the Center of Economics and Financial Analysis and the Spatial Technologies and Concepts Division. The team includes the following people:

Tom Bonny – Financial Analyst
Holger Hinsch – Senior Economist
Jung Lim – Geospatial Analyst
Tom McCarty – Senior Systems Analyst
Les Speir – Senior Systems Analyst
Holly Zanoni – Geospatial Analyst

What is the scope of this project?
The scope of the SAIC task is limited to refreshing business requirements, developing architecture alternatives, and presenting a business case to support the architecture recommendations.

What is the objective of the study?
The objective of this study is to develop a comprehensive requirements and cost-benefit analysis study report for addressing the management of geospatial data for better program delivery. The report will address specific and primary business requirements of the three Service Center Agencies involved in the Service Center Modernization Plan: Rural Development (RD), Natural Resources Conservation Service (NRCS), and the Farm Service Agency (FSA).

What type of information will be addressed?
The areas that the report will address include, but are not limited to, critical business requirements, tangible and intangible benefits, life cycle costs, multiple alternatives, payback ratio, and recommendations for implementing a geospatial information architecture.

What type of factors are involved in determining a geospatial information architecture?
Factors that must be taken into account include organizational realities such as limited bandwidth, aspects of security, computing systems capacity, impacts of deployment on limited resources, and impacts of alternatives on telecommunications and security.

For whom is this report being prepared?
The product of this task order will be used as a communications vehicle for the Service Center Modernization Initiative (SCMI) and for departmental and congressional staff. It will also be used to communicate plans for geospatial data management and GIS implementation to agency staff at all levels. The information collected for the report will be used to justify and support the business case for additional funding and investments for future fiscal years. The final report will be used as a communications vehicle for how the government moves to the target geographical information system architecture.

Who will be interviewed?
A number of informational interviews will be conducted in order to obtain current information related to business requirements. As determined by the COTR, interviews will consist of primarily representatives from FSA, NRCS, and RD. Information Technology Working Group (ITWG) and the National Association of Conservation Districts (NACD) representatives will provide additional information. Interviews will include participants from technical, scientific, and executive backgrounds and representatives from federal, state, and local levels.

What deliverables are expected?
The final deliverable is a requirements and cost-benefit analysis document that thoroughly identifies options and recommendations related to managing geospatial data for better program delivery.

What happens after the interviews?
After the interviews SAIC will develop alternative geospatial information architectures based on the identified business requirements, conduct a cost benefit analysis of the architectures and produce the requirements and cost benefit analysis document. The document will be reviewed by the COTR. Consolidated comments

will be provided by the COTR to SAIC and a final document will be produced. A briefing will be developed and two presentations will be made to audiences to be defined by the COTR.

Appendix C: Questions

COST-BENEFIT ANALYSIS OF GEOSPATIAL INFORMATION ARCHITECTURE (GIA)

AS-IS Scenario - Current resources

- What is your ultimate mission? Who is your customer?

- What do you do? What services does your office provide?
  - How do you do it?
  - What resources are involved? (Man-power, overhead, etc)
  - How does your function relate to the big picture?

- Define your critical geospatial business requirements.
  - What type of geospatial information are you concerned with and what is the purpose of the data?
  - What methods and procedures are you currently using to acquire, integrate, and deliver data to service centers?
  - How is the geospatial information and data processed? (Is it run through a computer program; calculated through mathematical models; or compared to various texts, such as the Farmers Almanac and a hypothesis concluded?)
  - Is the geospatial information used primarily within the county or at the state level, etc?

- How satisfied are you with the rate at which your geospatial goals are being achieved?

- Are the tools and methods the same today as five years ago?

TO-BE Requirements

- Are your geospatial business requirements being met? If not, which areas and how can these be improved?

- Given how you have described the AS-IS, explain where you want to go in the future. Define your future vision.

- What is currently lacking to help you effectively accomplish your mission? Why do you need this? What are the benefits?

- Considering GIA functionality, how would your job change? What would you do differently? How would the overall resources involved change?
  - E.g. internal benefits – It will only take employee X 5 hours instead of 7 hours a week to perform a certain task

- How will this change affect your customers?
  - E.g. external benefits – Farmer X will no longer have to travel to the county agency to get certain information, resulting in a time saving of 10 hours per month.

Specific GIA Strategies

- What type of geospatial data do you think would be most beneficial to meet your business requirements. More specifically, what type of geospatial data will meet the business program (such as EQIP or WHIPP) for all service center agencies?

- What is the most effective method of providing GIA training (one-time vs. continual, initial training in lab environment followed up with computer-based training vs. exclusively computer-based vs. web-based, etc)? When do you feel that training should be implemented (before or after the equipment is delivered) – what would be the acceptable lead-time?

- What is the added value of having mobile computing available to assist with your business needs? What efficiencies are generated?

- Are you familiar with or do you use the Customer Service Tool Kit? What requirement does this address? What benefits/efficiencies does it provide to both the user and the customer? Are there quantifiable benefits?

- Studies have indicated that all three agencies (FSA, NRCS, and RD) agree that there are four critical geospatial themes that must be addressed in order to effectively implement the Service Centers: soils, orthoimagery, common land unit (CLU), and cultural and demographic data [GIS Strategy for Service Center, IV and 4-1]. Do you agree or disagree with the previous statement? The studies also suggest that other themes have been identified, but are of varying importance form one agency to another. How would you employ the geospatial data in order to meet your business requirements? NRCS focus: Do you think SSURGO development for state offices, MLRA (major land resource area) offices, digitizing units, and the NCGC national cartography and geospatial center would help you with your business requirements?]

- Is any of your geospatial data considered sensitive, secure, proprietary, etc? What are current practices for securing this data?

- If a new Geospatial Information Architecture were implemented, what advice would you give the implementers?

Appendix D: Abstract of Notes from Interview Sessions

DEFINING BUSINESS AND FUNCTIONAL REQUIREMENTS *Includes business and functional requirements necessary to successfully accomplish tasks for the agency and customers*
BUSINESS AND FUNCTIONAL REQUIREMENTS FSA
Acreage reporting and compliance should be done first, and then the benefits will be noticed and they will move forward. If there are ten new programs, nine will involve GIA technology.
Common Land Unit (all data is under the CLU) - needs digitizing and ongoing maintenance
Compliance
Compliance - digital imagery compliance is primary focus
Compliance imagery – need digital compliance (new imagery)
Concerned with compliance
Congress enacted 21 new programs for FSA to administer. State GIS coordinated has been involved in best possible was to report on that program. The ability to provide good data to provide policy makers from the state level is critical for Congress to address problems
Conservation Reserve Program (CRP)
Development and implementation of technology a requirement
Easements pose another concern
Eligibility for programs is an issue
Five states (Kansas, Minnesota, Missouri, Nebraska, and Texas) are essentially digitized (Kansas is 85% complete); the other states are only 0-15% digitized - still a long way to go
Focus: Coordinate, share data, create forum. Intra-governmental (need to follow through)
FSA: 90% business is done via in-house facsimile.
Having compliance photos underneath layers (would be) tremendously helpful.
In Minnesota, demonstrated the maintenance tool and compliance tool and everyone was excited. In FSA, have not moved ahead with any single usage of this product. The problem is not at the county or state level, but in the national level. One program area should be chosen and move forward.
LAYERS
ONLY REALLY CONCERNED WITH CLU – MOST CRITICAL CONCERN IS DEFINING THE FIELD BOUNDARIES
Primarily acreage reporting. Determine actual acreage via orthoimagery (but the orthoimagery is too big for common database?)
Proper program delivery
The APFO (Air Photo Field Office) associated with fundamental photography, not production. APFO, past: Manual operation. aerial photography; Integrate, manage, and rectify data; deliver via hardcopy only (would handle ten million negatives). APFO, present: digital; seamless orthophotos (3-4 million orthophotos are produced per year). APFO, future: aerial; digital; reformat; as accessible as possible (web-based?). Price the kink.
Training mandatory
BUSINESS AND FUNCTIONAL REQUIREMENTS NRCS
Business plan – does not necessarily entail GIS architecture
Business requirements: IT support center – meet program areas (mostly accounting and financial business requirements, no known true need for GIS, except for MAP LAYERS) and link risk management data with KCMO data (shareable) – may need to share GIS data
Concerns include flood plain maps
Currently in process of refreshing business requirements
Currently there are 300,000 sites made of 800,000 points; Each site is 40-60 acres; The Congress REQUIRES that USDA provide status of land using statistics. A five year survey is conducted to monitor the resource trends; 73,000 sites are sample annually and 40,000 sites are sampled every year.
Currently, NRI is in a transitional stage where data collection is a critical task and for every 5 years, the survey is being conducted
Data has to be digitized (so can be updated) since books are outdated almost immediately
Facilitate procurement of tools to help field office perform job
Mission: soil mapping (GIS important for inventory), technical soil services, SSURGO digitizing site, digital map finishing, ICCS (inventory), etc.

DEFINING BUSINESS AND FUNCTIONAL REQUIREMENTS (continued) *Includes business and functional requirements necessary to successfully accomplish tasks for the agency and customers*
BUSINESS AND FUNCTIONAL REQUIREMENTS NRCS
Mission: to make sure information is at fingertips and can use it to make decisions. Most of the customers are NRCS people familiar with GIS, mostly at the county level: virtually all the data is now digital (supports: soil survey, ArcView extensions, PL-566 program, conservation technical assistance, county level digital for three years – 30% or less; state level digital for three years – 75-80%)
NRI database – remote sensing activities collect info for database (currently migrating from hardcopy to digital copies)
Mission: to implement desktop GIS into picture regarding conservation planning. Integrate GIS into business workload into public domain: Web based, Client based.
NRI maintains and monitors national database including the collection of remotely sensed data (digital orthophotos, HUC, watershed boundary, easements, geographic delineation).
Once every 5 years Congress requires that USDA provides status of land (monitor changes and trends in land use). Statistical data set. Much of this information is done manually through photography, sometimes requires field visit.
Programs in the field that KCMO supports (currently found on paper products): need ability to take farm reports and validate them, work with NRCS on conservation projects
Required to construct trend model of natural resources every five years
The national database includes the collection of remotely sensed data (digital orthophotos, HUC, watershed boundary, easements, geographic delineation): 15-20 states are using mostly digital methods for sampling sites whereas in the past sites were sampled using hardcopy photo and ancillary source materials; Some sites still require ground-truthing; PDA's have been proven to be very effective; 20-30% of the sites are currently done digitally.
There should not be a GIS requirement, it should be a business with GIS capabilities
Through strategic planning and coordination with states and counties, the NRI is helping with brining conservation tools to field.
Track what is on the ground via imagery; most of the data involved is presented via remote sensing
Transformation from hardcopy to digitization is in progress
BUSINESS AND FUNCTIONAL REQUIREMENTS RD
Business requirements: include incorporation and accessing of many layers (such as wetlands, floodplains, soil properties, etc.)
Electric: finance telecommunications facilities. Have accounting, technical, and engineers personnel – have about 30 people working around the country, Expensive to gather (pre-)loan information – it costs around $100,000 to collect data (Engineering costs are generally at least 10% of the construction fee and RD pays for those engineering costs)
Environmental analysis – delivered differently for each of the three agencies
Program analysis and program delivery is very important
Purpose: environmental issues, population, income, HOH, employment, etc
BUSINESS AND FUNCTIONAL REQUIREMENTS OTHER
OCIO/ITWG: not satisfied with rate at which business requirements are being achieved – if more aggressive in date development and acquisition, (easily) could have implemented many more ArcView licenses (around 6000-7000 licenses)

TOOLS *Includes mention of various tools (software, hardware, mobile) and some associated benefits*
TOOLS FSA
$64 per sq. mi. for imagery. DOQ is $5/sq mile. State and counties may not have the influence the satellite vendors. Bethel's lab will have to manage a lot of this coordination. In MN the satellite passes are every 8 days and it may be cloudy most days
35 mm replacement: 9" film - (metric) yielding true color negative and IR (best for crops) – already scanned, geocoded, and rectified. All digital – use digital camera with GPS and IMU and use satellite imagery. (16:1 savings using 9" film vs. 35 mm slide (because 16 times bigger than 35 mm slide)
Admittedly, most of the benefits of implementing a GIS are intangible (respondent POV).
APFO is announcing bids for using digital imagery for Minnesota this year. The announcement should be out this year. Products range from sections or entire county mosaic of sections. All of the products will be geo-referenced and ortho-rectified. No vendor has produced this product for anyone yet. Different vendors are interested in the product and they all have different approaches. Typically they want to do a portion of the state, but no one has offered up the entire state.
Applications: CLU digitizing tool, CLU maintenance tool, QC tools, acreage reporting tool
ArcInfo would have worked out-of-the-box (if originally introduced); however, in-house tools already created and implemented via ArcView (not ARC 8)
ArcView has been helpful because of the ability to use many layers
ArcView has the ability to BUFFER
ArcView out-of-the-box has a much larger learning curve but the toolkits within are fairly straightforward (more or less point and click)
Benefits of implementing GIS: FSA – customer 60-65% savings; employee 25% savings.
Congress enacted 21 new programs for FSA to administer. State GIS coordinated has been involved in best possible way to report on that program. Thee ability to provide good data to provide policy makers from the state level is critical for Congress to address problems
Conservation: environmental sign up yields 35-40% error rate. The rate could be decreased with automation/computer assistance (based on the land); ArcView – has the ability to BUFFER; Planning tools (same tools as used by the NRCS) have been created but no interface linking to the GIS capabilities; GIS is now used for mapping, but yet cannot pinpoint information (not all digitized)
Contrast accuracy of past (hardcopy) data: rectified images – available only in agricultural area (in farms and fields) and are not georeferenced (rectified only to 1%) Vs. Digital images – available everywhere and are georeferenced to the ground AND to the images throughout the entire image
Currently make maps via GPS and physically going out and plugging in each site (can exchange information freely this way)
Currently using COBAL. It would be easier to use advanced programs
Customer Service Toolkit – most beneficial when teamed with GIS: aim is to improve quality. Manually, would have to make photocopies, cut, paste, and mark with pens, etc. Digitally, it can be accomplished in just a few minutes by the touch of a couple buttons (portable access capable). Can access the entire Soil Survey database and can, therefore, make multiple assessments in just a short time. However, covers just conservation planning. Incredibly user friendly to use this NRCS application
Demonstrated the maintenance tool and compliance tool and everyone was excited. In FSA they have not moved ahead with any single usage of this product. The problem is not at the county or state level, but in the national level. Should pick one program area and move forward
Digital imagery compliance is hoped for this year's crops (via ArcView): GPS receivers most beneficial for tracking crop progression and results
Each (FSA) Service Center (within next few years) will have a GPS unit
Future of Customer Service Toolkit: eventually, should be able to download a clipped image of a much larger image and should be able to use PDA's in conjunction with CST (NRCS application)
GIS tools needed to maintain CLU (Maintenance tool exists and is in use. Respondent POV, however).
GPS quite important, but still do not have
Digital cameras are currently being used to take shots (takes good pictures). It is pricey, but the currently used 35mm slides do not provide the same quality
Hard copy maps at 1:660,000 scale. Using the planimeter you have to take three readings, and each has to fall within certain error rate or else have to do it all over (repetition). (Current compliance methods use hard copy aerial photographs. Respondent POV, however).
Hardware needed in order to maintain CLU: high-end workstations (one per service center), GPS (one per service center), and slide scanner (three per state)
Have no digital cameras – still on slides (35mm photographs).

TOOLS (continued) *Includes mention of various tools (software, hardware, mobile) and some associated benefits*
TOOLS FSA
IKONOS is expensive. Acreage reporting is one process, compliance is another. If compliance is improved, then acreage reporting may not be needed. Imagery could be used for other purposes like CRP. Currently, the NRCS person has to go to the field and delineate on hardcopy photos. Easements can be more effectively collected with imagery and GPS. This saves fieldwork time, staff and producer time. It could also be used for RMA and disaster uses. We should look at multiple uses of data so to bring the cost down.
IKONOS imagery is the perfect scenario (very high resolution), but too expensive
Imagery could also be used for compliance for CRP. The NAPP program could benefit for conservation with compliance of wetland. There is an enormous amount of time litigating compliance issues. With regards to time spent on appeal, if you can show a committee a picture then you reduce the amount of time arguing. Compliance is done only on a percentage, but with this technology the could have 100% compliance.
In Texas, just having ArcView in the state office has been a tremendous benefit (bringing in layers of crop reports, weather data, insurance data, etc. great benefits)
In Texas, one county has been digitized. In working with the BPR sites, once the county geospatial data is digitized, then a lot of data can be linked from the legacy systems. Eradication of Bowl Weevils is a big issue in Texas. Up to now the Bowl Weevil people map each cotton field with GPS (they are currently using a different numbering system from the state inspection agency. They could use the same layers and ID system and share data (i.e. acres, name of produces,. Crop reports, etc)). They have formed a working group in the state to look at buying satellite coverage as a cost sharing: they were targeting 3-4 flights for about $50K for each agency interested in partnering (have been able to do some pretty good crop ID in the spatial sciences lab in DC, central and north Texas is a bit easier)
In Texas, the state GIS person visited the CED and showed them with an image where the cotton was planted - just 30 minutes in the office revealed insurance abuse
Lack of ArcView licenses (7500 people across the country are involved with conservation efforts; 2200 ArcView licenses bought last fall and distributed) (NRCS)
LANDSAT imagery was not as clear as IKONOS (where it was good it was great but where it was bad it was very wrong) (LANDSAT may have worked better with crop identification, but not good for measurement) as the resolution of LANDSAT is 30 meter and for IKONOS is one meter
Limiting flights is the probable scenario, unless compliance rules are changed
MAP saves an unbelievable amount of time, for appeals alone.
Network and LAN/WAN makes data movement much easier.
Old way: 30 days to do county (slides, pneumonic planimeter, etc). There is a percentage of every compliance that has to be done in the field, but new way: a matter of a few hours or days
Once every 5 years Congress requires that USDA provides status of land (monitor changes and trends in land use). Statistical data set. Much of this information is done manually through photography, sometimes requires field visit: @ 300K site nationwide. Do @ 73K site per year, but @40K of these are the same ones that need to be redone annually. Therefore, at current rate, can't capture every site within 5 years; Using photography, can do 6-7 sites per day. With digital imagery can do 10-12 sites per day. 15 to 20 states started using digital imagery last year. @20 to 30% of 300K sites using digital imagery. Large time savings with digital imagery.
Only small percentage uses GPS for groundtruthing, but GPS very beneficial (FSA services do not lend need for other forms of mobile computing). Do need web. Mobile computing – not a high percentage of external benefits. Does allow for better Ag policy, faster decision-making, and better customer service. Initially expensive, but the benefits outweigh the costs. Could (somewhat) consolidate some of the forms and processes involved with the forms (thereby reducing burden).
Ortho-rectified imagery (DOQs) would significantly benefit/reduce time spent to "truth" second generation
Replace wheels/chains with GPS
Satellite imagery product reduced process from 30 days to 3 days. However, the satellite product was not as accurate due to resolution. 35 seconds per field, 4.5 fields per farm 180-190 farms. 20 hours to compete compliance. Primary issue with this is cost. Pilots for whole mosaic has been done. There is a lot of cost to doing it internally, but the cost to contract it out is higher. The hope is that the geo. They found that the state has other partners that are interested in cost-sharing which would drop the cost further. They expect county, water boards, Dept. of natural resources and Ag. in MN to partner. Is expected that the overall cost will be less due to sharing opportunities.

TOOLS (continued) *Includes mention of various tools (software, hardware, mobile) and some associated benefits*
TOOLS FSA
Spatial Analyst and Imager Analyst were tested for rectifying imagery. The preferred method is Spatial Analyst (with Image Warp)
Twenty-one new programs were implemented this past year. The policies and procedures set in one state may (adversely) affect what happens in a bordering state. In other words, technology may help organize thoughts more efficiently so that more comprehensive decisions can be drawn, it is much easier to have the data at fingertips rather than scattered amongst several state offices (with some data available only at certain offices).
Using GIS, eligibility could be enhanced in the state office (they queried information from counties to show which fields have HEL. As each layer was digitized they queried and looked it and found that 400-500 fields did not have the determination that should have. This job could not have been done before)
Wheel or chain measurement vs. mobile (GPS) measurement. Example 1: used to take 3-4 people non-stop for 1-11/2 weeks to rectify photography; now, with GIS tools, it is just a matter of adding a new layer. Example 2: freehand, it took 2 people 1 year (in Kansas) to generate compliance (and that was if no projection changes were needed); now it is just a matter of maintaining the upgrades and adding new layers
When people are comfortable with the technology, the things move forward, TOGETHER. Once they do this, all of the queries are the same. The BPR's all evolved into the same thing, but they were never moved forward.
TOOLS NRCS
(On-site) mobile computing – laptop (downloading information near real-time). PDA linked to GPS is far more accurate. The CST offers a timesavings of 4:1. One-on-one assistance is CRITICAL (can draw and download information on computer and create CD right there in the field and give it to the customer immediately (accurate data, timely delivery, instant customer satisfaction)
Currently, structure encompasses numerous packages (encompassing all or partial packages of ERDAS, ESRI suite, and many others). However, it would be more efficient to have just one package common between each of the offices/agencies
Customer Service Toolkit would best utilized if integrated with a GPS unit (CST WOULD be able to be supported on this type of system)
Data collection is a critical task above anything else: use of GPS for field data collection linked with PDA and aerial photos is reliable and efficient; PDA's and GPS have played a MAJOR role in the effectiveness of data collection.
Enterprise GIS: hopeful that it will be implemented, but moving along very slowly. Now, there are hundreds of copies of ArcView, but the enterprise license has not been implemented. Just cannot wait until everything is perfect before implementing – should put into practice right away
ERDAS Imagine is very powerful, but very complicated (learning curve)
Field staff is still using air photos and a grease pencil; they are more than ready to use GIS. Ideally, each field office would have stand alone ArcView licenses
Future: ArcView, GPS, more customization, shareable data, higher speed service, use more current flight photography (using 1995)
GIS: analysis, maps-are-us, Customer Service Toolkit
GPS allows to preplan before ever going out into field. (GIS digitized drainage area: ArcView = few minutes Vs. Planimeter = hours or more likely days)
GPS incorporation can offer ALTERNATIVES, which were not available before
GPS is easy to use (just a matter of point and click technology)
GPS use in the field is only about 10%, 90% still using the wheel and chains
Have decent computers, but could use more RAM and disk space
Have three people to serve as GIS support team
Hotlines are beneficial (live interaction), including "computer see – take over and make mouse move"
Incorporating GPS and PDA technology has allowed for a more effective means of sampling and has, hence, generated more accurate and better quality results
Instead of sending in forms and coming into office regularly, could just pull up the layers using GIS
KCMO: (FSA) GIS is a VERY NEW thought, its implementation has not even been discussed yet (GIS world is not necessary at this point – GIS is a long-term goal)
KCMO: (FSA) Now, have to sift through books in order to obtain insurance information. (GIS layers could potentially aid in overhead costs regarding the extraction of data)

TOOLS (continued) *Includes mention of various tools (software, hardware, mobile) and some associated benefits*
TOOLS NRCS
Mission: to implement GIS service center with the "Tool Kit" included. Survey soils and GIS (primarily ARCView and Tool Kit): Most of the work is doing using the "Customer Tool Kit"
Mission: to implement GIS service center with the CST included. Survey soils and GIS (primarily ArcView and Toolkit): most of the work is doing using the CST: cost share the (eight) layers (layers include the DOQs, hydro, hypso, landuse, etc). About 20 people in the state office doing various tasks, 100% of staff involved with geospatial integration (they are a digitizing center there in Texas; Can turn out 3-4 mosaics per week whereas Salt Lake City can pump out more mosaics per week; most of the work is done using the CST
Mobile computing and ArcView allows for fewer visits by both office officials and the customer (still need to make a minimum of two visit per year, one for initial eligibility and another for certification of a crop)
Must investigate differentials (regarding GPS) - need to use the most efficient differential rate available
Need to insure implementation of a standard GIS tool kit
Now use: ArcView interfaced with Microsoft; also using Customer Service Toolkit
Now, have to make copies of maps and send that away rather than pulling up on computer screen
Now, mostly extract data by using books and paper maps
PDA-linked to GPS – the concept is good, but the program used currently is too cumbersome.
Pros of digital imagery: better quality of data, less administrative tasks for states, increase speed of data collection, and centralized data collection
Since its implementation in 1997, GPS has been incredibly beneficial for time and quality savings, as has the incorporation of PDA technology
Soils section: completely automated regarding remote sensing, GIS: analysis, maps-are-us, CST, GIS support
Technical direction is the long-term vision, utilizing the proper tools to perform image analysis (using such tools as ERDAS, ArcInfo, etc)
The (soil scientists) need updated imagery. It would be optimal to have PIN technology, with rectification done on the fly. Pin technology – is very high-end technology. It entails a laptop with special screen that can be easily used in the (bright and sunny) field. It is rugged. It can hold large amounts of data within, much more than could a PDA. It allows for analysis right there in the field. It would best if integrated with a GPS unit. The Customer Service Toolkit WOULD be (able to be) supported on this type of system
Transfer of data from one location to another: when using special software packages to share data, there are editing rules, requiring valid entries. NRI finds this procedure to be efficient and secure way of moving data back and forth
Transforming from hardcopy to digital data is in progress: digital data provide more efficiency, less manual labor (versus using pen and paper), a higher quality and resolution, analytic capabilities, time saving, consistency, and accuracy
Use of GIS and imagery technology (remote sensing data - soil, digital orthophotos, HUC, watershed boundary, easements, geographic delineation)
Using GPS for field data collection linked with PDA and aerial photo is efficient and accurate
TOOLS RD
Benefits of GIS: program management and policy, underserved areas are identified and addressed – better delivery of services, tabular form presentable in map form – maps allow for same (tabular) data to be displayed in a more apparent (it "pops out") form, better comparisons are achieved (including rates in population, etc) – allowing for better targeting of areas, especially when addressing county level and below county level areas (even some civil rights concerns are present and GIS points out how to target those underserved areas more appropriately)
Combination of services AND quality is achievable no other way than by GIS
Digital access of information allows for better quality and faster access
GIA could be greatly ENHANCED by the use of (digital) technology
GIS helps with applications
GIS is ideal for evaluating environmental concerns
Regarding software, need complete packages (we are not necessarily computer savvy)

TOOLS (continued) *Includes mention of various tools (software, hardware, mobile) and some associated benefits*
TOOLS OTHER
NACD: Jim Woods: "Idaho One Plan" - primary focus: to bring down to the producer's level (Jim Wood ® jwood@agri.state.id.us or www.oneplan.org). Internet application, server that allows the ability to locate property (via ARC-IMS). User can just click a "clipped" area. Data files are clipped to make file smaller. User downloads software (10 MB) or deliver via CD. Would be free (or as cheap as possible) to the user. Uses MAP-OBJECTS to handle map projects (in conjunction with USGS and ESRI products). ESRI charges only $20 per delivery for us rather than the standard $100 for general customers.
NACD: Need to implement database management system
NACD: 319 GPA Grant (1-2 year grant) – for nutrient management. Using ArcView – will finish digitizing soil and ortho layer this year
NACD: Arc-IMS allows for unlimited number of users at any one time; ArcView allows for only one user per license at one time
NACD: CST Vs. Idaho One Plan – both have pros and cons
NACD: Customer Service Toolkit is not affordable by every state; options: ArcView. (most are being trained to use the CST (now) but in about a year or so, must learn ArcView)
NACD: FSA has own GIS toolbars / buttons which are beneficial
NACD: GIS (ESRI) has been implemented since 1997 (used primarily for watershed delineation). Have many layers already digitized. GIS allows for information to be drawn upon readily: Example: 320,000 acre watershed via digitizing takes only one year VS. manually taking three years
NACD: GIS allows for digital measurements, buffer zones, and (re) calculations.
NACD: Have implemented GIS (ArcView) in some offices. Five sites are providing information only on an "as-needed basis".
NACD: It is much easier to maintain one centralized Arc-IMS rather than having to maintain every ArcView license on each desktop
NACD: Orthoimagery currently being used is fairly old, @10 years old
NACD: Sunbelt-10-10 (A grant in Oregon provided through ESRI) Strategy: to respond to Clean Water Act and Wildlife Conservation practices, set up local management agencies, have one license of ArcView 3.2 and a laptop, 750,000 acres of crop minus 100,000 of conservation land. Took the remaining 650,000 acres
NACD: Survey-grade GPS is needed for watershed analysis, urban areas, etc. in order to achieve LOCATION ACCURACY. Garmin works fine though (it is within 15 feet accuracy and costs only $200 Vs. high price tag of GPS). Problem with Garmin is that currently the are about ten steps required in order to get it compatible with ArcView (but that could easily be obtained by writing a simple script)
NACD: There are 3000 conservation district offices; ideally would have one license per office (= 3000 separate ArcView licenses). ArcView and Arc-IMS are critical (ArcInfo not demanded too much, yet)
NACD: Use of CST would be helpful: quality product to the producer, but there is a high-end cost to the NRCS, @$800 per license, most of the staff is not at GIS level
NACD: Using ArcView (will finish digitizing soil and ortho layer this year)
OCIO/ITWG: As far as is concerned, there are three architectures: CCE, telecommunications, and security
OCIO/ITWG: GIS is definitely improving the quality of life (because more informed decisions can be made than in the past)
OCIO/ITWG: RMA figures that there is 20% fraud due to people lying about what is truly in their field. Although not yet capable everywhere, GIS would reduce rates of fraud by allowing detection of fraud via imagery
OCIO/ITWG: The potential for RD and heightened technology is enormous
OCIO/ITWG: The tools used today are not at all the same as the tools used five years ago
OCIO/ITWG: With GIS (and even GPS), customers are offered many more options in just a few minutes time rather than several hours later

COSTS AND BENEFITS (MOSTLY INTANGIBLE) *Includes costs and benefits of various technologies, tools, programs, etc and corresponding examples*
COSTS (AND BENEFITS) FSA
$64 per sq. mi. for imagery. DOQ is $5/sq mile. State and counties may not have the influence the satellite vendors. Bethel's lab will have to manage a lot of this coordination. In MN the flights are every 8 days it may be cloudy most days
Cost-sharing with partners is definitely beneficial
CRP could be cut 50%. Acreage reports on-line could reduce staff time tremendously and reducing staff
Data now capable of being queried in fifteen minutes would have taken at least a month to do manually. Example: Having access to a digital camera for air photos allows for field time of about thirty minutes and casual conversation for obtaining a field report vs. waiting for satellite imagery
Has a cost analysis study been conducted before? Not really. 30-35% of staff hours could be reduced if did work at table rather than behind counter. If could do work (customer service) online, needed visits could be greatly reduced; Employee happiness is important. Now, feel overworked. Two and three county offices are combined creating double and triple amounts of work per employee
How much is spent coming into the office? In Kansas, required to come in twice (once to certify crop). The amount of time spent in the office is anywhere between ten minutes and eight hours, plus travel time between the farm and office. Crop reporting is a major job
If do not get enough money out to farmers in time, get charged for services AND added interest
IKONOS is expensive. Acreage reporting is one process; compliance is another. If compliance is improved, then acreage reporting may not be needed. Imagery could be used for other purposes like CRP. Currently, the NRCS person has to go to the field and delineate on hardcopy photos. Easements can be more effectively collected with imagery and GPS. This saves fieldwork time, staff and producer time. It could also be used for RMA and disaster uses. We should look at multiple uses of data so to bring the cost down
It would have taken an employee at least 1-2 month to find HEL problem where it took less than 15 minutes to with the information in the GIS. It told us where to look and to find specific problems. Without this technology, this problem would never have been addressed. You could do some analysis, to find out how much soil is lost without farming with a soil conservation practice. This could be estimated. They are also making payment to a producer without verification that they are doing the conservation
Just having ArcView in the State office has been a tremendous benefit
Old way 30 days to do county (slides, planimeter, etc). There is a percentage of each compliance that has to be done in the field, the 30 days does not include this. The technology may offer software that is 80% accurate of identifying the ground cover. $265K to do compliance the new way (respondent POV)
One-time large data effort (and cost), then it is a matter of updating and maintaining. Option: partner with others to share the common information
Only small percentage uses GPS for ground truth, but GPS very beneficial (FSA services do not lend need for other forms of mobile computing). Do need web. Mobile computing – not a high percentage of external benefits. Does allow for better Ag policy, faster decision-making, and better customer service. Initially expensive, but the benefits outweigh the costs. Could (somewhat) consolidate some of the forms and processes involved with the forms (thereby reducing burden)
Ortho-rectified imagery (DOQ's) would significantly benefit/reduce time spent to "truth" second generation
Refer to FSA-GIS Business Case chart of annual service center business costs
Satellite imagery product reduced process from 30 days to 3 days. However, the satellite product was not as accurate due to resolution. 35 seconds per field, 4.5 fields per farm 180-190 farms. 20 hours to compete compliance. Primary issue with this is cost
Satellite remote sensing is almost a crucial component, but the jury is still out on the absolute importance of incorporating satellites. They are very expensive and are not as accurate (resolution differences). Example: it costs about $64/mile2 for satellite imagery vs. about $5/mile2 for mosaic (This is respondent POV. If it is a reference to IKONOS the cost estimate is incorrect)
Saving field time and office time
Savings may have to be projected program by program. Has anyone ever done this analysis? KC should have information of overpayment, but it is not clear how much would be saved with GIA
Spatial Analyst with image warp and Image Analyst were delivered and tested at several pilot program sites – Spatial Analyst ultimately preferred – ultimate potential to shave off time
Timeliness is certainly an issue. It takes a lot of time to collect (flight – photo) data – the window of opportunity during a given year is only about sixty days due to weather and seasons: If a whole state could be photographed (flown) within a month; the number of flights could be reduced
Time saving is not in the photography itself, it is in the post processing (rectifying via plane or via computer program): There is no savings in the initial cost, but there is savings in the maintaining, detecting fraud/violations, etc; Not a direct savings dollar to dollar, but there certainly is within INTEGRITY
Updated digital imagery: FSA willing to pay for it

COSTS AND BENEFITS (MOSTLY INTANGIBLE) (continued) *Includes costs and benefits of various technologies, tools, programs, etc and corresponding examples*
COSTS (AND BENEFITS) FSA
Warehousing of data is necessary – cost-effective to keep centrally located, but who shall be in charge of the centrally located data?
Work Measurement Numbers (FSA): It takes 30 days to do compliance in Minnesota. With new satellite process, it takes only 3 days or 20 hours for compliance. Caution: there is a cost hidden amongst the processes – more expensive but quality is much better. If already rectified, much labor time will be saved. Example: in Minnesota, savings exceeded millions due to cost-sharing – dropped finances dramatically
COSTS (AND BENEFITS) NRCS
5-year lifecycle is optimal timeframe since technology is evolving
About 15-20% of issue is financial component
Benefits are recognized all the way around, both internally and externally
Can do double the number of PSUs with digital imagery
Cost benefit would be to produce detailed quality data that public can share, but some data are confidential and is treated as secure information
Cost-effective training: initial classroom, hands-on experience with a FOLLOW-UP
Costs less with improved technology. There have been instances where money has been granted in order to provide more accurate data (capable of being generated only via improved digital technology)
Currently, 20 – 30% of the sites are sampled digitally. Types of data that are communicated include: digital orthoimagery, easements, geographic delineation, and watershed delineation
Currently, information (soils of the land) are stored in books. In the process of converting into digital format
Customer service is important. Example: Farmer X does not have access to a computer or does not know how to read and write – Farmer X needs assistance. Reallocation of staff would be shifted from serving the "Haves" to serving the "Have-nots". Outreach would entail explaining to Farmer X that the library has computers available (sharing resources)
Customers willing to pay for certain digital info – hence value is what customer is willing to pay
External benefits are harder to quantify since other diverse groups use the data such as university researchers. For instance, Iowa State University is working on research and analysis, designing database to obtain technical solutions. Other groups such as government policy makers may have other solutions
Higher quality imagery is produced through digital processing saving time, gaining more accuracy measurements, and reliability of data
Internal benefit includes having dedicated staff to concentrate of full time data collection and GIS work to benefit each service centers
Internal benefit includes having dedicated staff to work full time of GIS related work to produce quality data in a timely manner
Mission: to implement GIS service center with the appropriate tools included (primarily ARCView and Customer Service Toolkit): cost-share the (eight) layers (layers include the DOQs, hydro, hypsography, land use, etc.); about 20 people in the state office doing various tasks; 100% of staff involved with geospatial integration (they are a digitizing center there in Texas; can turn out 3-4 mosaics per week whereas Salt Lake City can pump out more mosaics per week
Monitor occurrences on continual basis. No longer have to go back and forth in order to collect data (significantly decreasing ground truth missions)
More accurate (and up to date) data is better for the customer
National procurement standard for quality of photography has been implemented
Of 300,000 sites: 40,000 of are sampled each year, and an additional 30,000 are viewed about once every five years (about 73,000 sites are sampled per year)
Since reorganizing and introducing digital technology, there has been significant benefits recognized
Sites that have gone digital are generating better quality, and more accurate data; the time required has been significantly reduced (e.g.: PSU's via manual method yields 6 to 7 per day vs. PSU's via digital method: yields 12 to 14 per day)
Some of the information costs should be shareable among agencies
There needs to be plenty of room for growth (but not too much room. Example: don't need a car that goes 160 mph if the speed limit is only 60 mph; however, need to be able to keep up if the speed limit changes. Since the speed limit would change only a little (say to 70 or 75 mph), it would be practical to have a car that can do maybe 80 mph

COSTS AND BENEFITS (MOSTLY INTANGIBLE) (continued) *Includes costs and benefits of various technologies, tools, programs, etc and corresponding examples*
COSTS (AND BENEFITS) NRCS
To-be benefits include the use of single software suite analysis, increased resolution imagery, timeliness, and training
Updated (satellite) coverage is limited due to weather constraints
Up-to-the-minute help within agency is valuable (e.g.: if have question involving an image, can deliver image via digital means and obtain an immediate answer from another source rather than waiting for much longer or simply winging-it)
Weakness within agency: how much will it cost, including long-term costs (such as implementation and maintenance). And benefits. Need to identify the most direct AND cheapest method. Example: I can get there, but how do I get back?
COSTS (AND BENEFITS) RD
Cost benefit to share data among agencies
Greatest barrier is a staff, capable of using the technology (putting ideas into motion). Example: "must sharpen the saw"
Tremendous amount of money could be saved by implementing ArcIMS platform: example: $80,000 to set up needed hardware and software. If web-able: 300-500 properties can then up the price by @$2000 (low-end estimate)
COSTS (AND BENEFITS) OTHER
NACD: District offices would very much like to move ahead but tend to be very limited (example: have an average of three people per office, so if one person leaves, a wealth of information is lost)
NACD: Have cost-shared land cover data (specifically soils data) with NRCS NACD: Cost: Currently districts are purchasing GIS on their own and are paying retail prices. If they do not have the funds they cannot use GIS tools to their fullest potential. NACD: Need CLU data for farm planning maps.

THOUGHTS FOR THE FUTURE *Includes thoughts regarding the future of the Service Center Agencies business affairs*
THE FUTURE FSA
APFO: Future: Aerial, digital, reformat, as accessible as possible (web-based). Price!
Digital imagery compliance is hoped for this year's crops (via ArcView)
Future of Customer Service Toolkit: Eventually, should be able to download a clipped image of a much larger image, should be able to use PDA's in conjunction with CST (NRCS)
Goal is to make the four images into one mosaic image (with seams) and the make that one image seamless
If an unlimited budget, would have a consolidated digital databases
Improve workflow between service center staff and other agencies
Provide public with their individual data regarding their own land (but otherwise the information would have to remain private – sensitive data)
Readily view current (crop) conditions
Replace 35 mm compliance slides with digital imagery
Replace paper maps (scaled photos) with digital photos (digital orthophotos)
Replace pencils with PC's and GIS
Replace wheel/chains with GPS
THE FUTURE NRCS
Centralized data is more desirable rather than having data scattered throughout field offices. It is more favorable to have groups of states to handle data (full time data collection from 1000 to 20 staff migrating to digital) rather than having 2,500 field locations
ArcView, GPS: more customization, shareable data, higher speed service (need more current flight photography (using 1995))
Common computing environment
Enterprise GIS: hopeful that it will be implemented, but moving along very slowly. Now, there are hundreds of copies of ArcView, but the enterprise license has not been implemented
Eventually, hope to make a soil survey available to the public
KCMO: (FSA) Telecommuting lines (proper bandwidths in place)
Layers available at local basis (local office)
Standardization of programs
The vision of NRI is to move forward with digital processing for more efficiency, accuracy, consistency, and timeliness
Training: update and then stay stable with that software package long enough to get the bulk of personnel on the same playing
THE FUTURE RD
Share data among agencies (RD wants to be the one who makes viable, sustainable communities in America)
Vision: Can put in information and make instantaneous recommendations – buffering and site selection project planning
THE FUTURE OTHER
NACD: Co-location of offices and networking is ideal situation NACD: Continue to include partners in IT planning NACD: Continual training program NACD: GIS available to all Conservation Districts

THE GREATEST BARRIER *Includes the responses to the question: What is the greatest barrier standing in the way of you achieving your business requirements? (may overlap with concerns and needs) (critical attention)*
GREATEST BARRIER FSA
Ability to use maps (query/layers/etc) is a CRITICAL feature needed to incorporate with digitizing maps. Old maps are causing havoc. Digital maps would solve an estimated 90% of training programs.
Duplication of records
Need to pick just ONE program area and focus on it. The focus should be on MAPS, because maps serve as the foundation. The maps need to be converted into digital format.
Rate at which advanced into technology – have not moved forward
GREATEST BARRIER NRCS
Ability to absorb technology
Budget and staffing (human resources)
Budget restrictions – must simplify contracting procedures
Contracting problems
Databases available and integrated in forms capable of being shared
Differing bandwidths, redundancy of data are some other barriers
Everything is currently piecemealed together; therefore, need consistency and standards among the architectures (among the agencies, the states, and the counties, etc. There must be COMMUNICATION
FSA and other agencies do not have same priorities in collection of data - need standardization
Full time staff (from 1000 to 20 staff migrating to digital) to dedicate their efforts on a specialized area such as GIS. Each service agencies handle data differently. Due to differing data sources, data layers are not coincident between boundaries (vertical integration of data). This includes county and state boundaries
Funding inconsistencies
KCMO: (FSA) Building the data layers
KCMO: (FSA) Getting technology components in place
KCMO: (FSA) Need to have ability to construct data and database (but costs money)
Lack of data layers
Maintaining centralized data in groups of states rather than 2,500 separate field offices
Mandatory and updated (continual) training
Must replace rather than adding onto already existing new methods.
Organizational and people issues - there are differences between processes amongst the various offices (all are at different levels of technology, especially involving the many layers)
Resources and costs
Telecommunication bandwidth
The agencies are data-rich and information-poor
GREATEST BARRIER RD
Lack of resources
Setting up the infrastructure and implementing the tools
Staff, capable of using the technology (putting ideas into motion). Example: “must sharpen the saw”

THE GREATEST BARRIER (continued) *Includes the responses to the question: What is the greatest barrier standing in the way of you achieving your business requirements? (may overlap with concerns and needs) (critical attention)*
GREATEST BARRIER OTHER
NACD: Automation (user-friendly)
NACD: Budget
NACD: Communication between agencies (management hierarchy)
NACD: Data development of CLU, soils, and DOQs
NACD: Database management system
NACD: Duplication of information
NACD: EASILY and efficiently reaching the customer
NACD: Elongation
NACD: Equipment (hardware, software, printer, etc.)
NACD: Training
OCIO: Keep the people and infuse some technology
OCIO: Money
OCIO: The agencies are personnel-rich and capital-poor. The world runs on capital investments, which has been lacking within the agencies for many years now, Keep the people and infuse some technology

PRESSING CONCERNS *Includes concerns expressed (often overlapping with barriers and concerns) (major attention)*
CONCERNS
FSA
Has not been a smooth transition from one level of technology to another. Concerns lie within having to start/stop/start/stop over and over. And programs are changing too rapidly to keep up.
As far as FSA is concerned, FSA should be in charge of orthoimagery and CLU's must be managed locally.
Average age of farmer is over 50. Only about 25% have a computer, and even less know how to use it. – it will have to be a complete generation turnover
Bandwidth issues: In 1997, six counties had gone digital; in 2001, there are 300 counties that have gone digital – therefore, bandwidth issues
Base maps. Some are 1991 some are 1993. Maybe they don't have to use a higher price of orthorectified every year. It is conceivable that the states could be done in parts with orthorectfied and parts with non-rectified to stretch out the costs. They would rather have the imagery every year. The partners may also prefer to have the imagery flown every year.
Clients are getting so far ahead in terms of manipulation of data and technology; very soon we will not be able to keep up and our purpose will be lost
Compliance software is not moving forward as fast as they like. Also, looking at contracting out to have compliance slides delivered as orthorectified imagery. Not a lot of leadership in this area. Compliance slides are still not digitized. Majority of the country is using commercial pilots, but not necessarily an air-photo firm. APFO is put in charge of putting forth standards for using digital cameras and scanning for compliance.
Concerned about second generation of imagery, and how boundaries will change
Currently digitizing counties in Kansas with ten year old imagery
Customers would be provided web-access of data under read-only ability
Data storage is very vast
Every 5-7 years, would have to update database. It would take one person 1 year to update the line work. With digital imagery, line work is already present and kept up to date
Funding poses a major concern. 80-90% (200 county lines) of the country is available DOQs – 500 mosaicked DOQs – entire country could be mosaicked
Goal is to make the four images into one mosaicked image (with seams) and the make that one image seamless
Have DOQs for most of country, but are not mosaicked together
Ground measurements are incredibly time consuming
If could get the orthorectified imagery then that would help the 2nd generation problem. Also, if the imagery is timely, why would they need to have the producers need to come in and certify. They county person could due the certification send a report to the producer, and the producer would confirm. This could be 70% accurate and save the producer a lot of time. This is a public benefit. There is a problem due to the accuracy of the crop.
If partner, can share with others common or overlapping data: aggregate data. But there need to be decision support tools.
In Kansas, one huge difference is working with the producers and understanding what is going on. Having the ability for a digital copy sent to you is much simpler than paper (second generation of photocopy that has been faxed). Oversight will be much better
Internal issue: development and implementation of technology
Lack of bandwidth
Lack of leadership
Many misconceptions about GIS
Maps are not current and are very out of date. By the time maps are updated (via longhand), they are out of date again (generally utilizing maps that are ten years old)
Money is not the issue, it is the bureaucracy
Must define the field boundaries
One program area should be chosen and move forward (acreage reporting and compliance should be done first, and then they will see the benefits and move forward). If there are ten new programs, nine of them will involve GIA technology
Oversight of various activities. Currently converting to GIS environment. There is lack of conformity, which is a major concern. Need to have the ability to move data into a user-friendly manner. With the little bit of technology already implemented, digital means of communicating data is more efficient and related more quickly. Digital means make oversight better.

PRESSING CONCERNS (continued) *Includes concerns expressed (often overlapping with barriers and concerns) (major attention)*
CONCERNS FSA
Priorities not being met - some places have begun digitizing data before FSA has had a chance to set standards – therefore, FSA eventually has to go back and redo the same effort so as to get the information it needs, defining CLU
Problem: limited resources.
Random selection of farms taken – 10% of the farms randomly selected (and 3% are required checks) – 2 million farms total – 260,000 per year. Therefore, there is muck work overload.
Regarding online applications, security is an issue and electronic signatures are being investigated
RMA compliance is a big issue. In the past 2.5 weeks over $300M dollars have been put out very quickly. The county spends so much time to find where the acres are so they just write the check. They are concerned that some counties are pushing the money out and other counties are not getting their payments out. Then they can expect a call from Washington inquiring why the payments did not go out. There is data out there on the amount of interest paid because the payment did not go out. Some of payments are 60 days late. The customer is aggravated and the government pays interest. In some cases, the money is demanded back, and there is not an opportunity to get the money back. This technology would help make the right decision. Many times, the programs are initiated a year after the fact and there is not record. Image could help. Livestock Assistance Program is new. There could be cases where two ranchers are using and taking credit for the same pasture.
Some of the producers (farmers) are not coming forth with all the information (fraud), so (FSA will) have to run back and forth to ground truth/verify information/statistics
State office looks for uniformity. In working with half the counties, they are seeing tremendous opportunities where the lack of uniformity is a problem; they have been much quicker at handling and fixing problems. They ability to move data and create views of data in more user-friendly ways, they are much more able to communicate problems at various levels of the architecture
There are privacy concerns since some components are considered sensitive
Time spent could be 10 minutes or all day twice per year. Office could do the whole county in one week. In areas that have multiple plantings, one flight July 1-July 20 to catch newly planted crop and catch wheat stubble. KS has 6 pilots. It may not be enough to do the whole job. Dan is talking to someone who flies at 15000 at 200 mph. They would prefer to use fewer pilots, but the window of opportunity is 60 days. TX spends 500-700K to get slides. In TX one is interested in advancing the technology. Currently only what is needed in the CO is flown. Only the cropland is flown. In MN and KS almost the entire county is flown.
Timeliness is certainly an issue. It takes a lot of time to collect (flight – photo) data – the window of opportunity during a given year is only about sixty days due to weather and seasons. If a whole state could be photographed (flown) within a month; the number of flights could be reduced, Need more efficient method of gaining data (aerial), the rule of thumb is to fly only the croplands, remote sensing is almost crucial
Training is very limited but very important
Warehousing of data is necessary – cost-effective to keep centrally located. The concern: but who shall be in charge of the centrally located data?
When it takes so long to move forward, the programs have changed and the previous information is not good anymore. For example, NAPP will change next year and part of it that GIS would have helped does not exist
With error rate: if make inaccurate measurements and tell Mr. X the wrong information, Mr. X makes business decisions based on the wrong information (and the land boundary is half a mile off), the business could go wrong and now two errors have occurred (unnecessary)
CONCERNS NRCS
50% of workforce will be eligible for retirement (60-70% of senior management) within next few years. There will be a shortage in some disciplines, with weaknesses in administrative support, contracting, IT, personnel, and management
50-60% of the scientists and field employees are nearing retirement within next five years
A typical office visit: takes about twenty minutes. Location of most Missouri offices are fairly centralized throughout the state, so the average commute is about a half hour (but in the bigger western states, the commute can be several hours, each way)
About 15-20% of issue is financial component
Certain data are classified. Generally, the sites are confidential, but the results are considered public domain
Concern: overwriting data (configuration management). it is not necessarily yet an issue, but it will be very soon. Have already implemented an in-house "data versioning" type of program
Congressional mandates are still in effect, although some are archaic. It is important, then, to recognize such policies.

PRESSING CONCERNS (continued) *Includes concerns expressed (often overlapping with barriers and concerns) (major attention)*
CONCERNS NRCS
Data information transfer (NASIS) is complicated. The problem is that have just gone to a central server (posing bandwidth issues). Offline editing may be a possibility.
Each site (2500 in all) has a different level of technological capability. Effective use of data is a big problem
Estimates: minimum 150 gigabytes server for centralizing database
GIS has allowed for much better quality of maps and can be produced in much less time. What would take several weeks before now takes only a few hours.
Having one IT staff serving all three agencies would be detrimental because each has very different jobs serving very different missions. IT staff should be within each agency (but the agencies should definitely work together).
Important to have an intricate digital map as the base
KCMO: (FSA) Impacts of technology require increased bandwidth: need T1 technology (which is a lot of money)
KCMO: (FSA) Security Making sure that the data is not in the wrong hands and that official records are not tainted and that only officially/legally modified
Many resources spent on IT to keep all different systems each field office uses up and running and communicating between each other
Note: would NOT necessarily prefer NT workstation over UNIX workstation.
Obtaining a full time staff that is dedicated to performing specific tasks 100 per cent of their time would be far more efficient than ten people dedicating only ten per cent of their time
Proper security precautions are important
SCMI: Is not currently an enterprise web. However, must address customer
Security – most of the customers are on the outside, security will pose a problem on the inside due to all the firewalls.
Standardization of data a problem. Currently using 3 to 4 different software packages to collect digital info. Moreover, each state doing whatever it wants
Struggling with IT support: much wasted time due to the of lack of proper IT staff (the whole infrastructure needs to be in place with a common vision, rather than each office fending for itself)
The key is to get NRCS information and elevation databases to coordinate/register together
The misuse of data is an ongoing concern
There have been difficulties with the extensive size, compression capacity, and storage of files (bandwidth issue)
Web-based applications are important
CONCERNS RD
All three agencies do not have to be at the same level (NRCS is more technical and RD is not and should not be forced to be). It can be a mentor relationship
Better comparisons are achieved (including rates in population, etc) – allowing for better targeting of areas, especially when addressing county level and below county level areas (even some civil rights concerns are present and GIS points out how to target those underserved and unserved areas more appropriately
Better comparisons are achieved (including rates in population, etc) – allowing for better targeting of areas, especially when addressing county level and below county level areas (even some civil rights concerns are present and GIS points out how to target those underserved and unserved areas more appropriately
Can always have improvements on data gathering techniques
Data warehousing is a critical concern
Drawing from books now but would be much better to instantly pull up information on the computer
If RD is given the funds to create and implement the tools needed, the very least that would be achieved would be: an increase in efficiency and an increase in productivity (both by A VERY CONSERVATIVE ESTIMATE OF AT LEAST 5%). The accuracy and quality of data would be very much enhanced
Intimidation factor
It would be great to be able to get down to the sub-county level

PRESSING CONCERNS (continued) *Includes concerns expressed (often overlapping with barriers and concerns) (major attention)*
CONCERNS RD
Only way to achieve knowing exactly where things are located is via GIS
RD has the least amount of GIS training - Need user-friendly software and MUST HAVE focused training
Right now, not all the data is readily available nor is it necessarily in the right form
Security: Verisign (Company) – electronic signature
Time is of the essence
Training is limited
CONCERNS OTHER
NACD: None of the tract land data (Oregon) has been digitized
NACD: Bandwidth for ArcIMS vs. ArcView in order to support transferring of data is a major concern.
NACD: Bandwidth for ARC-IMS Vs. ArcView in order to support transferring of data is a major concern. Will need what type of bandwidth: T1, T2, dial-up?
NACD: DECISION SUPPORT IS LACKING ALMOST EVERYWHERE
NACD: Do not want to reinvent the wheel – NO MORE REDUNDANCIES. There is a definite lack of communication, especially when addressing who does what (and who is in charge of) task.
NACD: Not able to print large(r) maps on plotter (no plotter available)
NACD: Potential overlapping of information (and what Group A creates may not be used by Group B, for whatever reason)
NACD: Strategy: allow to download information from a database (shareable)
OCIO: Quite frankly, too much is being paid for the software

NEEDS *Includes the needs expressed in order to successfully transition into the initiatives of the Service Center (may overlap with concerns and barriers) (moderate attention)*
NEEDS FSA
35 mm film 2-3 times per year – needs to be digitized (in order to reduce paper)
Centralize information (including ownership, boundary lines, etc.) databases. Currently have to go back and paper trail way through the information.
Communication between the states is important. Many producers farm in several states across state lines
Conservation Reserve Program – models used (now) are crude. There is a large error rate (up to 50%) via manual methods. Need to focus on environmental matters (topography, soils, geology: karst vs. wetland). Need to tie into other models (databases: soils, endanger species, land use, geology, population, etc.). Needs linking together!
Consolidated digital database
Convert from paper to digital step one. We cannot create more problems than we can solve. If we can just get something out to the county to show productive use. Don't try to solve the whole thing at once, just show a key benefit.
Data must be shared
Digitized counties
Field reporting (for tobacco, acreage is reported in 10ths and 100ths). Example: there are 419 peanut offices – all of which are required to collect acreage data (compliance). No tools are currently used at the national level. TPD not running any pilots.
Firm budget from the get-go – so that know how to allocate funds. Consistent funding – would make agency run far more efficiently
Focus: Coordinate, share data, create forum. How does this happen? Office of OMB (Dennis Lytle) – intra-governmental (need to follow through)
FSA is in a motion of cutting staff. KS is taking an approach of shared management. Other states have shut down offices. It would be much easier to manage a county from a remote site if the data was at the fingertips
FSA needs to link with the NRCS – need to standardize tools (not yet available) and need to be encouraged/required to used the standard tool
If partner, can share with others common or overlapping data: aggregate data. But there need to be decision support tools
If want benefits, NEED THE FIELD BOUNDARIES
Imagery needs digital compliance (new imagery)
Leadership
Management – must keep organized and well coordinated
More efficient method of gaining data (aerial)
Must have ability to move data into a user-friendly manner
NATIONAL DATABASE AND STANDARDIZATION OF (META)DATA – currently using stand-alone mode and need to join data together into common database. Eventually, need to make web-able. 10% is common (shareable), 90% is still stand-alone
Need a simple way of integrating data
Need data!
Orthoimagery is too big – need field reporting (for tobacco, acreage is reported in 10ths and 100ths)
Ownership- boundary lines- capable, but needs to be more user-friendly. Now, measurements need converting (feet into meters, lat/long into decimal degrees, etc)
PECD – need to integrate information. It is not seamless. Downloading of information is somewhat cumbersome at this time (as there are many steps involved). It is important to have real-time post-processing
Pick just ONE program area and focus on it. THE FOCUS SHOULD BE ON MAPS, because maps serve as the foundation. The maps need to be converted into digital format
Problem: Set standards for themes (a published standard). Currently, stovepiped standards are in effect
Second generation editing still needed
set standards for photography
SHOULD MAKE A STRONG PLAN AND MANAGE USING THAT PLAN
Some things need to be managed locally and other things need to be managed centrally (bandwidth)
Standard base map on which hard copy maps could be generated
The maps need to be converted into digital format.

NEEDS (continued) *Includes the needs expressed in order to successfully transition into the initiatives of the Service Center (may overlap with concerns and barriers) (moderate attention)*
NEEDS FSA
There are many misconceptions about GIS. The insurance companies are mapping the fields and talking to the Dept. in Washington, but they are not doing it the way they need. USDA needs to be the leader in this effort. Congress has to report their acreage to so many places. USDA has to be the single point of contact for this
They should pick one program area and move forward
Updated imagery (satellite imagery?)
We have to focus and keep working at it and make some decisions so the benefits are realized
NEEDS NRCS
Agencies and groups within agencies should coordinate their priorities for data collection and software implementation
Common Computing Environment (CCE) WILL BE IMPLEMENTED within the next year
COMMON DATABASE – NEED TO LINK WITH THE CORPORATE WORLD
Common vision among all service centers necessary
Consistency
Consistency is critical
Email (and data delivery) must be delivered more timely fashion
Everything is currently piecemealed together; therefore, need consistency and standards among the architectures (among the agencies, the states, and the counties, etc. There must be COMMUNICATION
Having an infrastructure supporting centralized database is a good idea. There will always be a few folks who really understand the technology and can run with it – let them run with it and show off all the bells and whistles
Hydrography is needed, but problematic to secure, mostly due to registration – scale issues
Ideally, need more equipment
If staffing were sufficient, should implement GIA NOW; but because not adequately staffed, changes need to be incremental
In order to make the geospatial information architecture work, all service centers need to have a common vision where IT and GIS work side by side, training staff to dedicate on a specialized area of geospatial information functionality, having more resources available to make the right decisions
Information needs to get out, but how? Marketing approach, need to be available electronically
It is important to have an intricate digital map as the base
KCMO: (FSA) Advice to the implementers: make it multi-user updateable and make it user-friendly
KCMO: (FSA) If an unlimited budget: Infrastructure, data layers, equipment
KCMO: (FSA) Link Risk Management data with KCMO data (shareable) (share GIS data)
KCMO: (FSA) Need servers for storage, currently have no technology
KCMO: (FSA) Need shareable database
Make the data more available to the public
More investigation is needed regarding the importance of PDA's
More storage for data
More technology investments are necessary; the bigger problem is in the field
Must address the lack of adequate servers and bandwidth
Must incorporate a server with capacity big enough to keep information in-house
Need a "test of data" to see if the data works. Need a capacity to QC the digitized data after being transferred from analog
Need field offices and state offices on the same plane regarding GIS. Example: ESRI products just will not work for everything. For map finishing, some programs are still faster using UNIX platform rather than NT
Need spatial database; update (online) maps
Need to access more than one data source at a time
Need to migrate from manual to digital techniques. Various offices have instituted digital technology whereas others have not. However, the matter of efficiency is an ongoing argument. Agency-wide transitions are in progress

NEEDS (continued) *Includes the needs expressed in order to successfully transition into the initiatives of the Service Center (may overlap with concerns and barriers) (moderate attention)*
NEEDS NRCS
Plenty of room for growth (but not too much room Example: don't need a car that goes 160 mph if the speed limit is only 60 mph; however, need to be able to keep up if the speed limit changes. Since the speed limit would change only a little (say to 70 or 75 mph), it would be practical to have a car that can do maybe 80 mph
Service center – GIS is more for planning and program assistance. GIS is more consistent and better for documenting and programmatic assistance
Spatial rollups needed; shareable data
Standards – who is responsible for setting the standards and assuring they are kept, and at what scale?
Systems need to be able to communicate with each other
Telecommunications – need to be able to communicate at (sub)real-time. Rate of email delivery is an issue. Bandwidth is an issue
The (soil scientists) need updated imagery. It would be optimal to have PIN technology, with rectification done on the fly (pin technology is very high-end technology). It entails a laptop with special screen that can be easily used in the (bright and sunny) field. It is rugged. It can hold large amounts of data within, much more than could a PDA. It allows for analysis right there in the field. It would best if integrated with a GPS unit. The CST WOULD be (able to be) supported on this type of system
There must be sharing improvements among the agencies
Things that could improve situation: use FT data collectors rather than taking people from everywhere to help out when needed – improved efficiency, using digital imagery, digital processing, centralization
Unlimited budget: GIS capabilities (and later GPS) and current high-resolution data
Upgraded software
NEEDS RD
"Sharpen the Saw"
Access to demographic data, and need to be able to integrate demographics with the information
Architecture must be easy to use and MUST BE USEFUL
Combining of information from RD and FSA
Critical to recognize the end user (everybody within agency must be considered) (it is a cyclical nature of information)
Getting the soil survey and USGS quad sheets in digital form alone would be an incredible benefit
Need data (have the information)
NEEDS OTHER
NACD: Access to color plotters
NACD: Address compatibility from one application to another
NACD: Decision support
NACD: GIS compatibility needs to push hard for unified database. Need to address the INFRASTRUCTURE
NACD: Nicole McCoy has conducted survey about GIS and what is needed (same trends as found from SAIC interviews)
NACD: Soils and orthoimagery IN STANDARD FORM
NACD: Standardization is needed of CLU between FSA and NACD
NACD: Strong data management
NACD: USDA needs to iron out issues with server
NACD: CLU, Soils, and orthophoto layers per state
OCIO: $60 million needed (FSA) to complete digitizing CLU's, if have proper (software) programs, would be able to complete regularly in the office

TRAINING *Includes the prevalent trend regarding training and its obvious need of attention*
TRAINING FSA
Digital maps would solve an estimated 90% of training programs
Each site (2500 in all) has a different level of technological capability: and at different levels of training
Grasping the technology may be more difficult for some than for others - A large percentage of the workforce is nearing retirement
Lack of resources and training are greatest barriers
NRCS is highly trained whereas FSA is not as much so. There is a great need for training
There must be consistency of training among agencies
Training imperative
Training is a concern
Training is at top of priority list
Within FSA, GIS in minimally used; therefore, there are multiple levels of learning curves
TRAINING NRCS
Cost effective: initial classroom, hands-on experience with a FOLLOW-UP (continual)
Currently in Missouri: each step (in training process) builds one step on top of another, so the more repetition, the more recognition will occur
Do not want to train to use just the software, optimally want to train a new discipline (which must include some geography, such as coordinate systems and geographical thinking)
Each agency should have individual (and individual to each agency) training. It has to be customized in order to reap the fullest effects
Hardware and software training should be a priority in order to launch/continue GIS technology
Incremental: learn ArcView, then Spatial Analyst, then 3-D Analyst, then Image Analyst, etc.
In-house (tailored)
Initial training is one thing, but the training must be continual
KCMO: (FSA) Impacts of GIS – will need training and trainers
Learning curve: some cultural problems, such as pessimism
Learning curves involved. GPS – easy. Should be just a matter of point and click technology
Long-term and on-the-job in order to best utilize the tools
Maybe all (administration and all) should learn ARCView, but only the more advanced employees should learn ArcInfo
Must make the training mandatory, not voluntary for everyone
Must replace (not just on top of the old) training methods
Need computer training before even introducing GIS software packages
Ought to train the staff for practical purposes
Regarding the public, program should definitely be point and click or touch base technology (minimal training)
Replace rather than adding onto already existing new methods. It must be mandatory training
Should be appropriate according to the needs of data functionality and requirements
The report better be complete (and must include all costs – hardware, software, maintenance, training, etc)
Topic of training is not straightforward
Training is at top of priority list
Training is the biggest challenge since different service agencies implement different software and digitizing procedures. Everyone is at a different level in their training background in the use of GIS. For instance, due to differences in the data sources, data layers are not coincident between boundaries (vertical integration of data) and not "seamless" (horizontal integration of data) having connected networks and closed polygons
Training raises many concerns, since matching training with data and equipment is currently problematical (see above: organizational and people issues)
Want to update and then stay stable with that software package long enough to get the bulk of personnel on the same playing field before having to transition over to yet another level of technology

TRAINING (continued) *Includes the prevalent trend regarding training and its obvious need of attention*
TRAINING RD
All at different levels and having varying learning curves
Need common foundation and then build upon the core. Example: in-house small group training session (great thought and care must be taken: must teach small groups thoroughly and then can have that small group teach other small groups)
RD currently at very limited level
RD has the least amount of GIS training
Training is limited
Training should be continual and agency specific and must entail a hands-on experience. The learning curve is rather high (it is a culture shock)
TRAINING OTHER
NACD: Customized training
NACD: Delegate resources and responsibilities in order to strengthen training and knowledge base
NACD: If the GIS data is there, it is a matter of having ALL (even the farmers) understand how to use and to WANT TO USE the new technology
NACD: Most states are not using GIS because of lack of training, non-compatible computers, and the high expense. Those states that do not have the technology would benefit the most, since no advancements have been achieved
NACD: Need training in order to reap full benefits of GIS tools.
NACD: Training absolutely needs to be addressed. GIS is no good at all if it just sits on someone's desk
NACD: Training is barrier
NACD: Need customized training
OCIO: Kathy Green (MO) is probably the success story regarding training

Appendix E: Costs

This appendix provides a more detailed explanation on the calculations used to estimate the cost of each alternative. The costs presented are not discounted.

Sunk Costs

USDA provided the sunk costs. CST costs through FY00 are included. Table E-1 represents the sunk costs that were applied to all alternatives.

Table E-1. Sunk Costs ($ millions)

	FY85-00
Personnel	$9.5
Hardware	$0.0
Software	$9.0
Training	$7.7
Data	$115.0
New Development	$6.0
Miscellaneous	$0.0
Total	**$147.1**

As-Is Baseline

The total 10-year LCCE of the As-Is Baseline is shown in Table E-2.

Table E-2. As-Is Baseline 10-year LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	**$6.0**
Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Software	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	**$28.9**
Training	$0.1	$0.2	$0.2	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	**$1.1**
Data	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
New Development	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Miscellaneous	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	**$20.0**
Total	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$5.6**	**$56.0**

Personnel

Personnel costs were estimated at $600K per year for additional support for those Service Centers that have already implemented GIS.

- **Hardware**

No hardware will be purchased that specifically supports GIS.

Software

Software costs were based on information provided by ESRI on both the current number of ESRI software licenses and GSA schedule rates. Table E-3 lists each license and its appropriate cost.

Table E-3. ESRI Software Maintenance Cost

ESRI Software	No. of Licenses	Maintenance Cost	Annual Cost
ArcInfo1	496	$2,168	$1,075,328
Network1	6	$520	$3,120
Tin1	106	$520	$55,120
Cogo1	62	$520	$32,240
Grid1	204	$520	$106,080
ArcScan1	33	$520	$17,160
ArcStorm1	1	$439	$439
ArcExpress1	20	$148	$2,960
ArcPress for AI1	69	$208	$14,352
ArcSDE Extension1	1	$3,900	$3,900
ArcView for Unix	234	$571	$133,614
Spatial Analyst Unix	41	$723	$29,643
Network Analyst Unix	3	$515	$1,545
ArcView IMS Unix	1	$1,316	$1,316
3D Analyst Unix	2	$723	$1,446
SDE	5	$3,900	$19,500
ArcIMS	14	$1,316	$18,424
ArcView for Windows	3370	$363	$1,223,310
Spatial Analyst Win	114	$619	$70,566
Network Analyst Win	23	$307	$7,061
ArcView IMS Win	2	$1,316	$2,632
3D Analyst Win	29	$619	$17,951
Street Map Win	4	$5,716	$22,864
Business Analyst Win	0	$3,120	$0
Tracking Analyst Win	1	$636	$636
Image Analyst Win	10	$1,079	$10,790
ArcCad	2	$307	$614
PC ArcInfo	4	$619	$2,476
DAK	10	$203	$2,030
ArcPad	4	$307	$1,228
MapObjects	13	$410	$5,330
MapObjects IMS	4	$1,316	$5,264
Atlas	5	$234	$1,170
		Total Annual Cost	**$2,890,109**

Training
Training costs were estimated at $75K in FY01, $150K in FY02 and FY03, and $100K in FY04 and out.

- *Data*

No data development investment would be required since no national GIS system has been implemented.

- *New Development*

It was assumed that no application development efforts would occur since GIS has not been deployed.

- *Telecomm*

Not applicable to the baseline.

▪ Miscellaneous

An additional $2 million was added to cover the cost of other miscellaneous tools that the USDA currently uses such as planimeters and chains. As mentioned in Section 6, this figure is extremely difficult to quantify. It is difficult to accurately estimate due to the large number of uncertainties that would arise if no further investment in GIS were made. However, a baseline is needed when performing a CBA to better assess alternative solutions. In performing the analysis, many expressed that these costs would likely be considerably higher. However, rather than running the risk of over inflating the baseline, thereby skewing the results even more towards a GIS investment, a conservative estimate of this cost was used.

o To-Be Distributed Alternative

The total 10-year LCCE of the To-Be Distributed Alternative is shown in Table E-4.

Table E-4. To-Be Distributed Alternative 10-year LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$11.4	$13.0	$21.3	$19.7	$18.0	$18.0	$18.0	$18.0	$18.0	$18.0	**$173.2**
Hardware	$18.3	$18.3	$9.3	$9.3	$9.3	$9.3	$9.3	$9.3	$9.3	$9.3	**$110.6**
Software	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	**$36.5**
Training	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$8.3	$10.6	$9.4	$8.3	**$81.6**
Data	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$22.2	$22.2	$22.2	$22.2	**$289.9**
New Development	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$7.8	$7.8	$7.3	$7.3	**$71.5**
Telecomm	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Miscellaneous	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$54.4**	**$87.6**	**$85.0**	**$87.4**	**$91.9**	**$80.6**	**$68.5**	**$70.8**	**$69.1**	**$68.0**	**$763.3**

▪ Personnel

The personnel costs cover the cost for deploying and maintaining each alternative over the 10-year lifecycle. It includes GIS and IT specialists. GIS specialists will provide training on the use of GIS including software, data, and related items; support business leaders in training on applications; coordinate development, acquisition, delivery and maintenance of data themes including partnerships at the state and local level; and conduct GIS analysis in support of state and local programs. IT specialists will support software and hardware installation and maintenance for GIS tools including GIS software, file allocation, system administration, printer and plotter support and maintenance, and network and other information systems needs.

Table E-5 details the yearly FTEs required. This information was provided by the USDA. An average cost (salary and expenses such as travel) of $93,137 was used.

Table E-5. GIS and IT Specialist FTEs and Annual Cost ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
GIS Specialists	104	104	175	175	175	175	175	175	175	175
IT Specialists	18	36	54	36	18	18	18	18	18	18
Annual Cost	$11.4	$13.0	$21.3	$19.7	$18.0	$18.0	$18.0	$18.0	$18.0	$18.0

Hardware

Hardware costs are based on a combination of information provided by the USDA and SAIC's own estimates. It includes the cost of one high-end workstation per Service Center, one high-end printer per Service Center, one plotter per Service Center, 5000 PDAs, and upgrading the application servers for GIS use. The initial purchase cost for these items was split over FY01 and FY02. Thereafter, a quarter of the total initial purchase cost was added per year to maintain a four-year refresh cycle on these hardware purchases. In addition, hardware for data repository was added based on 10% of the hardware costs for the on-line data warehousing of the To-Be Centralized Alternative. The data repository costs assume FTP and CD-ROM data delivery. These costs are constant through the 10-year LCCE. Table E-6 represents a break out of all hardware costs.

Table E-6. 10-year Hardware LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Data Repository	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
PDAs	$0.5	$0.5	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3
Application Server	$7.1	$7.1	$3.6	$3.6	$3.6	$3.6	$3.6	$3.6	$3.6	$3.6
Workstations	$3.0	$3.0	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5
Printers	$2.4	$2.4	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2
Plotters	$5.0	$5.0	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5
Total	**$18.3**	**$18.3**	**$9.3**	**$9.3**	**$9.3**	**$9.3**	**$9.3**	**$9.3**	**$9.3**	**$9.3**

▪ Software

The USDA provided this estimate based on the projected ESRI 5-year enterprise wide agreement cost. At the end of the five years, maintenance costs are expected to remain constant.

▪ Training

Training costs include training on ESRI tools and any customized applications developed. For NRCS, FSA, and RD, it was assumed that each of their employees would receive a three-day training class. This cost was split over two years. In the third year, each employee would receive a one-day training class. This cycle continues throughout the 10-year LCCE. For RD, it was assumed that half of their employees would receive a one-day training class per year.

Total employees receiving training at NRCS was 9,600, at FSA 13,598, at RD 890, and at CD 7,000.

Yearly FTEs receiving training is shown in Table E-7. The number of FSA employees receiving training was lowered by the deployment factor discussed in Section 7. The level of training required by FSA employees is directly related to the availability of data.

Table E-7. Number of Employees Receiving Training

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
NRCS	4,800	4,800	9,600	4,800	4,800	9,600	4,800	4,800	9,600	4,800
FSA		2,720	3,739	9,519	5,779	6,799	13,598	6,799	6,799	13,598
RD		445	445	445	445	445	445	445	445	445
CD		3,500	3,500	7,000	3,500	3,500	7,000	3,500	3,500	7,000

Table E-8 lists the total days of training that will occur in each year. An average employee cost of $65,000 was used for all but CD employees. For CD, an average cost of $45,000 was used due to CDs lower employee costs.

Table E-8. Total Days of Training and Annual Cost ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
NRCS	14,400	14,400	9,600	14,400	14,400	9,600	14,400	14,400	9,600	14,400
FSA	0	8,159	11,218	9,519	17,337	20,397	13,598	20,397	20,397	13,598
RD	0	445	445	445	445	445	445	445	445	445
CD	0	10,500	10,500	7,000	10,500	10,500	7,000	10,500	10,500	7,000
Annual Cost	**$3.6**	**$7.6**	**$7.1**	**$7.3**	**$9.9**	**$9.4**	**$8.3**	**$10.6**	**$9.4**	**$8.3**

▪ Data

The USDA provided the data development costs. It covers the cost of the development of data including soils, orthoimagery, CLU, and compliance imagery for effective use of GIS technology. Annual data costs for FSA and NRCS are shown in Table E-9. There are no specific data costs for RD or CD.

Table E-9. Data Development ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
NRCS	$11.5	$14.0	$14.0	$14.0	$14.0	$14.0	$3.0	$3.0	$3.0	$3.0
FSA	$3.7	$17.9	$22.7	$25.9	$30.0	$19.2	$19.2	$19.2	$19.2	$19.2

▪ New Development

This estimates the potential investments that NRCS, FSA, and RD will make in developing customized GIS applications such as the CST. These estimates were provided by the USDA and are shown in Table E-10.

Table E-10. New Application Development ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
NRCS	$1.2	$3.5	$4.0	$5.5	$5.0	$5.0	$5.0	$5.0	$4.5	$4.5
FSA	$2.0	$3.0	$3.3	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5
RD	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3

▪ Telecomm

Not Applicable

▪ Miscellaneous

Not Applicable

o To-Be Centralized Alternative

The total 10-year LCCE of the To-Be Centralized Alternative is shown in E-11.

Table E-11. To-Be Centralized Alternative 10-year LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$10.8	$12.5	$20.8	$19.1	$17.4	$17.4	$17.4	$17.4	$17.4	$17.4	**$167.6**
Hardware	$12.2	$12.7	$6.6	$6.7	$6.7	$6.8	$6.6	$6.6	$6.6	$6.6	**$77.9**
Software	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	**$36.5**
Training	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$8.3	$10.6	$9.4	$8.3	**$81.6**
Data	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$22.2	$22.2	$22.2	$22.2	**$289.9**
New Development	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$7.8	$7.8	$7.3	$7.3	**$71.5**
Telecomm	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$64.3	$64.3	$64.3	$64.3	**$494.3**
Miscellaneous	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$54.7**	**$108.7**	**$117.9**	**$130.1**	**$144.3**	**$142.8**	**$129.6**	**$131.9**	**$130.2**	**$129.1**	**$1,219.3**

▪ Personnel

The To-Be Centralized Alternative has the identical personnel costs as the To-Be Distributed Alternative except for a lower requirement of IT specialists since all applications will be centralized. Table E-12 details the FTE requirements and annual personnel costs.

Table E-12. GIS and IT Specialist FTEs and Annual Cost ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
GIS Specialists	104	104	175	175	175	175	175	175	175	175
IT Specialists	12	30	48	30	12	12	12	12	12	12
Annual Cost	$10.8	$12.5	$20.8	$19.1	$17.4	$17.4	$17.4	$17.4	$17.4	$17.4

▪ Hardware

The hardware cost differences between the centralized and distributed alternatives result from moving to a web enabled centralized solution. The To-Be Centralized Alternative includes the cost of one high-end workstation per Service Center, one high-end printer per Service Center, one plotter per Service Center, 5000 PDAs, and upgrading network servers for GIS use. The initial purchase cost for these items was split over FY01 and FY02. Thereafter, a quarter of the total initial purchase cost was added per year to maintain a four-year refresh cycle on these hardware purchases. No upgrades to local application servers were estimated since all GIS applications will be centralized. In addition, hardware costs for an on-line data warehouse/data mart were included. The initial purchase cost of this system was spread out through FY06 based on the anticipated deployment factor identified in Section 7. A four-year refresh cycle on these hardware purchases was also included in the LCCE. Table E-13 represents a break out of all hardware costs.

Table E-13. 10-year Hardware LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Data Warehouse	$0.2	$0.8	$0.6	$0.7	$0.8	$0.9	$0.6	$0.6	$0.6	$0.6
PDAs	$0.5	$0.5	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3
Network Server	$1.0	$1.0	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5
Workstations	$3.0	$3.0	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5
Printers	$2.4	$2.4	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2
Plotters	$5.0	$5.0	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5

Total	**$12.2**	**$12.7**	**$6.6**	**$6.7**	**$6.7**	**$6.8**	**$6.6**	**$6.6**	**$6.6**	**$6.6**

Software
Same as in the To-Be Distributed Alternative.

▪ Training

Same as in the To-Be Distributed Alternative.

Data
Same as in the To-Be Distributed Alternative.

New Development
Same as in the To-Be Distributed Alternative.

▪ Telecommunications

Telecommunications costs are based on the information provided in the Modernizing Telecommunications for USDA Offices in New Mexico: A Blueprint for Action and assume an average bandwidth equivalent to two T1 lines (three megabytes). The study is still in progress and the actual experience may vary from these values. The final analysis report is due in October 2001. The total cost, comprised of installation costs, equipment costs, and monthly charges for service, is an average of the costs charged by five different vendors. This information is provided in Table E-14.

Table E-14. Different Vendor Costs for Increased Bandwidth

Vendor	Equipment Cost per Site	Installation Cost per Site	Initial Cost per Site	1 T1 Line Monthly Charge per Site (1.5 Megabytes)	2 T1 Lines Monthly Charge per Site (3.0 Megabytes)	3 T1 Lines Monthly Charge per Site (4.5 Megabytes)
Tachyon	$5,500	$900	$6,400	$1,100	$2,200	$3,300
UUNet	$6,000	$300	$6,300	$950	$1,900	$2,850
Hughes	$0	$1,500	$1,500	$4,000	$8,000	$12,000
Quest	$0	$1,300	$1,300	$1,000	$2,000	$3,000
MCI T1	$0	$0	$0	$4,822	N/A	N/A
MCI 2 T1s IMUX	$0	400	400	N/A	$5,762	N/A
MCI 3 T1s IMUX	$0	400	400	N/A	N/A	$15,406
Average Site Cost	**$2,875**	**$1,000**	**$3,875**	**$2,374**	**$3,972**	**$7,311**

If a higher level of service is desired the cost appears to be approximately linear for the monthly charge while the equipment and installation costs remain static. There are also a number of service expansion capabilities, vendor business models, and scalability and technological issues that are not addressed here. Given that any solution is likely to include a mix of telecommunications vendors and/or service modes, the best current approximation of the per site cost for telecommunication service is the average calculated above.

Table E-15 presents the cost factors specifically used for this CBA.

Table E-15. Cost Factors for Increasing to Two T1 Equivalent Bandwidth

One-time Installation Cost	$1,000
One-time Equipment Cost	$2,875
Monthly Recurring Cost	$3,972

It was assumed that the integration of two T1 equivalent lines at each Service Center would mimic the deployment factor identified in Section 7. Based on this factor, Table E-16 presents the annual cost (50% of total cost as discussed in Section 6) to this alternative for increasing bandwidth.

Table E-16. Telecommunication Costs ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
New Service Centers upgraded	270	810	405	405	405	405	0	0	0	0
Total Complete	270	1080	1485	1890	2295	2700	2700	2700	2700	2700
Annual Cost	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$64.3	$64.3	$64.3	$64.3

▪ Miscellaneous

Not Applicable

o To-Be Mixed Alternative

The total 10-year LCCE of the To-Be Mixed Alternative is shown in Table E-17.

Table E-17. To-Be Mixed Alternative 10-year LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Personnel	$11.1	$12.8	$21.0	$19.4	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7	**$170.4**
Hardware	$19.3	$19.8	$10.1	$10.2	$10.3	$10.4	$10.1	$10.1	$10.1	$10.1	**$120.7**
Software	$2.5	$10.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	$3.0	**$36.5**
Training	$3.6	$7.6	$7.1	$7.3	$9.9	$9.4	$8.3	$10.6	$9.4	$8.3	**$81.6**
Data	$15.2	$31.9	$36.7	$39.9	$44.1	$33.2	$22.2	$22.2	$22.2	$22.2	**$289.9**
New Development	$3.5	$6.8	$7.6	$8.3	$7.8	$7.8	$7.8	$7.8	$7.3	$7.3	**$71.5**
Telecomm	$7.0	$27.3	$36.2	$45.8	$55.5	$65.1	$64.3	$64.3	$64.3	$64.3	**$494.3**
Miscellaneous	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**
Total	**$62.1**	**$116.1**	**$121.7**	**$133.9**	**$148.2**	**$146.6**	**$133.4**	**$135.7**	**$134.0**	**$132.9**	**$1,264.8**

▪ Personnel

The To-Be Mixed Alternative has the identical personnel costs as the To-Be Distributed Alternative except for a lower requirement of IT specialists since all applications will be centralized. However, the requirement is slightly higher than the To-Be Centralized Alternative since this alternative is also a partly distributed solution. Table E-18 details the FTE requirements and annual personnel costs.

Table E-18. GIS and IT Specialist FTEs and Annual Cost ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
GIS Specialists	104	104	175	175	175	175	175	175	175	175
IT Specialists	15	33	51	33	15	15	15	15	15	15
Annual Cost	$11.1	$12.8	$21.0	$19.4	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7

- **Hardware**

This alternative is a mix of the distributed and the centralized alternatives. It includes all the same components found in the other two alternatives. The To-Be Mixed Alternative includes the cost of one high-end workstation per Service Center, one high-end printer per Service Center, one plotter per Service Center, 5000 PDAs, and upgrading application and network servers for GIS use. The initial purchase cost for these items was split over FY01 and FY02. Thereafter, a quarter of the total initial purchase cost was added per year to maintain a four-year refresh cycle on these hardware purchases. The upgrades to local application servers identified in the To-Be Distributed Alternative were included since this alternative does assume distributed capabilities. In addition, hardware costs for an on-line data warehouse/data mart were included. The initial purchase cost of this system was spread out through FY06 based on the deployment factor identified in Section 7. A four-year refresh cycle on these hardware purchases was also included in the LCCE. Table E-19 represents a break out of all hardware costs.

Table E-19. 10-year Hardware LCCE ($ millions)

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Data Warehouse	$0.2	$0.8	$0.6	$0.7	$0.8	$0.9	$0.6	$0.6	$0.6	$0.6
PDAs	$0.5	$0.5	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3
Application Server	$7.1	$7.1	$3.6	$3.6	$3.6	$3.6	$3.6	$3.6	$3.6	$3.6
Network Server	$1.0	$1.0	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5
Workstations	$3.0	$3.0	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5
Printers	$2.4	$2.4	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2	$1.2
Plotters	$5.0	$5.0	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5
Total	**$19.3**	**$19.8**	**$10.1**	**$10.2**	**$10.3**	**$10.4**	**$10.1**	**$10.1**	**$10.1**	**$10.1**

Software
Same as in the To-Be Distributed Alternative.

Training
Same as in the To-Be Distributed Alternative.

Data
Same as in the To-Be Distributed Alternative.

New Development
Same as in the To-Be Distributed Alternative.

Telecomm
Same as in the To-Be Distributed Alternative.

- **Miscellaneous**

Not Applicable

Appendix F: Quantifiable Benefits

This appendix provides a more detailed explanation on the calculations used to estimate potential benefits. It is broken out by NRCS, CD, RD, FSA, and external benefits. The benefits presented are not discounted.

NRCS

NRCS benefits were estimated from the USDA Business Case and validated and updated through interviews with USDA personnel. Only those benefits directly linked with GIS technology improvements were included. Table F-1 details the activity levels and annual benefits as identified in the USDA Business Case. As each To-Be Alternative provided a different level of functionality, each of the activity levels identified in Table F-1 was assessed to determine the percent of those benefits that each alternative would receive. It was assumed that the To-Be Mixed Alternative would provide full functionality. As some of the labor benefits result in resource reallocation, salary costs did not include fringe benefits.

Table F-1. Breakout of NRCS GIS Benefits

Activity Level	Time Savings	GS Level	Annual Hrs Savings	Benefit	Distributed Benefit %	Centralized Benefit %	Mixed Benefit %
A2.1.2.1 Determine Area	46%	GS-6	37,628	$501,520	100%	100%	100%
	46%	GS-7	15,051	$222,939	100%	100%	100%
	46%	GS-9	42,143	$763,565	100%	100%	100%
	46%	GS-10	105,358	$2,102,356	100%	100%	100%
	46%	GS-12	15,051	$395,463	100%	100%	100%
A2.1.2.2 Determine Cropping History	78%	GS-6	25,522	$340,161	75%	100%	100%
	78%	GS-9	30,626	$453,632	75%	100%	100%
	78%	GS-10	58,700	$1,063,537	75%	100%	100%
	78%	GS-11	25,522	$509,266	75%	100%	100%
	78%	GS-12	12,761	$335,284	75%	100%	100%
A2.1.2.3 Determine Land Eligibility	81%	GS-6	13,252	$176,622	100%	75%	100%
	81%	GS-7	644,028	$11,668,668	100%	75%	100%
	81%	GS-9	371,045	$7,403,949	100%	75%	100%
	81%	GS-10	21,203	$464,825	100%	75%	100%
	81%	GS-12	26,503	$696,359	100%	75%	100%
A2.1.4.1 Complete On Site Inspection	22%	GS-6	10,798	$143,914	100%	25%	100%
	22%	GS-7	21,595	$319,869	100%	25%	100%
	22%	GS-9	253,384	$4,590,874	100%	25%	100%
	22%	GS-10	100,778	$2,010,949	100%	25%	100%
	22%	GS-11	23,035	$504,995	100%	25%	100%
	22%	GS-12	7,198	$189,134	100%	25%	100%
A2.1.4.3 Develop Schedule of Application	60%	GS-6	39,264	$523,325	75%	25%	100%
	60%	GS-9	538,506	$9,756,792	75%	25%	100%
	60%	GS-10	302,333	$6,032,848	75%	25%	100%
	60%	GS-11	125,645	$2,754,521	75%	25%	100%
	60%	GS-12	19,632	$515,821	75%	25%	100%
A2.1.5.2 Process	40%	GS-11	15,706	$344,315	100%	100%	100%

Activity Level	Time Savings	GS Level	Annual Hrs Savings	Benefit	Distributed Benefit %	Centralized Benefit %	Mixed Benefit %
AD245							
A2.1.5.3 Provide NRCS with AD862	31%	GS-11	16,229	$355,792	50%	100%	100%
A2.1.5.4 Perform On Site Inspection	25%	GS-6	16,360	$218,052	100%	25%	100%
	25%	GS-7	13,088	$193,860	100%	25%	100%
	25%	GS-9	80,982	$1,467,254	100%	25%	100%
	25%	GS-10	32,720	$652,906	100%	25%	100%
	25%	GS-11	26,176	$573,858	100%	25%	100%
	25%	GS-12	4,090	$107,463	100%	25%	100%
A2.1.5.5 Complete AD862	20%	GS-6	13,088	$174,442	100%	25%	100%
	20%	GS-7	5,235	$77,544	100%	25%	100%
	20%	GS-9	24,867	$450,551	100%	25%	100%
	20%	GS-10	55,624	$1,109,939	100%	25%	100%
	20%	GS-11	23,558	$516,473	100%	25%	100%
	20%	GS-12	3,272	$85,970	100%	25%	100%
A2.1.6.1 Perform Status Review (NRCS)	15%	GS-6	7,362	$98,123	100%	100%	100%
	15%	GS-9	104,050	$1,885,199	100%	100%	100%
	15%	GS-10	73,620	$1,469,038	100%	100%	100%
	15%	GS-11	8,834	$193,677	100%	100%	100%
	15%	GS-12	10,307	$270,806	100%	100%	100%
A2.1.6.2 Notify FSA	22%	GS-6	7,198	$95,943	50%	100%	100%
	22%	GS-9	25,554	$463,000	50%	100%	100%
	22%	GS-10	15,117	$301,642	50%	100%	100%
	22%	GS-12	12,237	$321,529	50%	100%	100%
Manipulate Spatial Data	75%	GS-6	134,970	$1,798,929	50%	100%	100%
	75%	GS-7	49,080	$726,974	50%	100%	100%
	75%	GS-9	245,400	$4,446,223	50%	100%	100%
	75%	GS-10	147,240	$2,938,075	50%	100%	100%
	75%	GS-11	29,448	$645,591	50%	100%	100%
	75%	GS-12	61,350	$1,611,942	50%	100%	100%
Maximum Total Yearly Potential NRCS Benefit				**$78,036,298**	**$65,612,181**	**$48,205,177**	**$78,036,298**

To determine the appropriate level of benefit for each To-Be Alternative, the NRCS maximum total potential yearly benefit was multiplied by both the functionality and deployment factors, as discussed in Section 7.

To estimate the risk-adjusted NRCS benefits, each of the identified time saving percentages was normally distributed with three standard deviations equal to 10% of the time savings percentage.

- **CD**

CD benefits are based on NRCS's benefits. Sufficient information was not available to make a comprehensive estimate of the internal benefits accrued by CD. However, based on the similarity of business functions performed by CD and NRCS, it was determined that basing CD benefits on documented NRCS benefits would provide a reasonable estimate. NRCS has 9,600 employees while CD has 7,000. Hence, CD is 27% smaller than NRCS and CD benefits were estimated by taking the NRCS benefits multiplied by 73%, to account for the difference in size between agencies.

RD

RD benefits were also estimated from the USDA Business Case and validated and updated through interviews with USDA personnel. Only those benefits directly linked with GIS technology improvements were included. Table F-2 details the activity levels and annual benefits as identified in the USDA Business Case. As each To-Be Alternative provided a different level of functionality, each of the activity levels identified in Table F-2 was assessed to determine the percent of those benefits that each Alternative would receive. It was assumed that the To-Be Mixed alternative would provide full functionality. As some of the labor benefits will result in resource reallocation, salary costs did not include fringe benefits.

Table F-2. Breakout of RD GIS Benefits

Activity Level	Time Savings	GS Level	Annual Hrs Savings	Benefit	Distributed Benefit %	Centralized Benefit %	Mixed Benefit %
A2.1.2.3 Determine Land Eligibility	81%	GS-9	20,505	$371,521	100%	100%	100%
A2.1.4.1 Complete On Site Inspection	22%	GS-9	1,856	$33,636	100%	25%	100%
	22%	GS-12	2,321	$60,972	100%	25%	100%
A2.1.4.3 Develop Schedule of Application	60%	GS-6	5,063	$67,482	75%	25%	100%
	60%	GS-12	12,658	$332,572	75%	25%	100%
A2.1.5.4 Perform On Site Inspection	25%	GS-9	2,110	$38,222	100%	25%	100%
Maximum Total Yearly Potential RD Benefit				**$904,405**	**$804,391**	**$504,742**	**$904,405**

To determine the appropriate level of benefit for each To-Be Alternative, the RD maximum total potential yearly benefit was multiplied by both the functionality and deployment factors, as discussed in Section 7.

To estimate the risk-adjusted RD benefits, each of the identified time saving percentages was normally distributed with three standard deviations equal to 10% of the time saving percentage.

FSA

FSA benefits were estimated from the FSA GIS Business Case, APFO's Strategy for a Changing Environment, and interview information. The information provided in the aforementioned reports was both validated and updated through USDA personnel interviews. Only those benefits directly linked with GIS technology improvements were included. Table F-3 details the FSA activity levels and annual benefits as identified in the FSA GIS Business Case. As each To-Be Alternative provided a different level of functionality, each of the activity levels identified in Table F-3 were assessed to determine the percent of those benefits that each alternative would receive. For FSA's internal benefits, both the To-Be-Distributed and the Centralized Alternatives received 90% of the maximum total potential yearly benefits, while the To-Be Mixed Alternative received 100%. As some of the labor benefits will result in resource reallocation, salary costs did not include fringe benefits. Moreover, some of the programs originally identified in the FSA GIS Business

Case no longer exist. However, the overall level of effort has not changed since the new programs require a similar level of effort.

Table F-3. Breakout of FSA GIS Benefits

Activity Level	Time Savings	Annual Workday Savings	Benefit
202 - Measurement Services	40%	6,707	$1,207,966
206 - Measurement Services	45%	5,931	$1,068,223
1418 – New Flight Aerial Photography	80%	51,583	$9,289,972
1401 - Acreage Report	65%	126,873	$22,849,394
1404 - Acreage Report	65%	2,217	$399,293
1405 - Acreage Report	65%	3,677	$662,191
1406 - Acreage Report	65%	1,510	$271,911
1407 - Acreage Report	65%	203	$36,599
1408 - Acreage Report	65%	103	$18,574
1410 - Acreage Report	65%	37,581	$6,768,200
1412 - Acreage Report	65%	4,443	$800,235
1415 – Acreage Report	75%	3,591	$646,762
1416 – Acreage Report	32%	10,479	$1,887,240
1402 – Maintaining HELC	20%	11,446	$2,061,421
1417 – Maintaining HELC	60%	2,728	$491,235
526 – Maintaining CRP	25%	18,648	$3,358,513
527 – Maintaining CRP	33%	6,767	$1,218,764
528 – Maintaining CRP	17%	12,821	$2,309,027
351 – NAP	42%	37,299	$6,717,428
301 – Farm & Ownership	45%	26,940	$4,851,705
302 – Farm & Ownership	55%	60,600	$10,913,835
501 – Conservation & Eligibility	12%	15,175	$2,732,938
506 – Conservation & Eligibility	7%	822	$148,011
222 – Conservation & Eligibility	19%	346	$62,326
229 – CAT	67%	13,256	$2,387,340
226 – CAT	12%	4,015	$723,055
2001 – Emergency Preparedness	7%	144	$25,909
2002 – Emergency Preparedness	9%	1,455	$261,977
2003 – Emergency Preparedness	9%	28	$5,098
2113 – Emergency Preparedness	33%	81	$14,508
Maximum Total Yearly Potential Benefit			**$84,189,648**

To determine the appropriate level of benefit for each To-Be Alternative, the FSA maximum total potential yearly benefit was multiplied by both the functionality and deployment factors, as discussed in Section 7.

To estimate the risk-adjusted FSA benefits, each of the identified time saving percentages was normally distributed with three standard deviations equal to 10% of the time saving percentage.

With the introduction of GIS, APFO's overall workload will increase. Table F-4 presents the APFO's change in anticipated FTE's required over the 10-year lifecycle (positives represent a decrease in the staffing levels).

Table F-4. Change in APFO FTE Requirements

Work Areas	FY02	FY03	FY04	FY05	FY06-10
Non-Rectified analog aerial photography	5.8	7.2	9.2	10.6	11.9
Data AID	-10.7	-10.7	-10.7	-10.7	-10.7
Rectified analog aerial photography	10.3	12.9	15.3	15.3	15.3
Customer Services	3	5.4	5.4	5.4	5.4
Contracting Services	-4.7	-9.5	-9.5	-9.5	-9.5
Data archive and distribution services	-0.8	-0.8	-2.1	-2.1	-2.1
Product Information	-1	-1	-2.4	-2.4	-2.4
Scanning Services	-1.9	-3.6	-5.3	-6.7	-8.1
Ortho-Photo generation	-3.3	-4.9	-10.1	-13.5	-16.9
Administration and Management	0	0	0	0	0
Yearly Change	**-3.3**	**-5**	**-10.2**	**-13.6**	**-17.1**
Yearly Benefit	**-$145,078**	**-$219,815**	**-$448,422**	**-$597,896**	**-$751,766**

Through USDA interviews, an additional benefit not previously identified was added. The Conservation Reserve Program (CRP) is a voluntary program that offers annual rental payments and cost-share assistance to establish long-term resource-conserving covers on eligible land. Each offer is ranked using the Environmental Benefit Index (EBI). The EBI helps ensure that only the most environmentally sensitive lands are selected and that all offers are considered fairly and equitably. Approximately 270,000 offers are made annually at a cost of $98 per offer. The EBI is a very labor-intensive calculation that is prone to a high error rate. This error rate ranges from 35% to 45%. Each time an error occurs the EBI is recalculated. GIS would significantly reduce this error rate as all land information and calculations could be done through the GIS applications. Assuming that the error rate could be reduced to 5%, the potential benefit was estimated at $9.1 million based on the annual cost of performing EBIs. Table F-5 details the factors involved in this calculation.

Table F-5. EBI Calculation

Cost per offer	$98
CRP eligible acreage	18,000,000
Range on average acreage per offer	65 to 70
Average offers per year	266,667
Cost to perform	$26,133,333
EBI Error rate	35% to 45%
Cost of Errors	$10,453,333
Benefit of Reducing Error Rate to 5%	**$9,146,667**

Triangular probability distributions were used on both the average acreage per offer and the EBI error rate.

External Benefits

Several quantifiable and non-quantifiable external benefits can be attributed to GIS. Following is a review of the four external benefits estimated in this CBA. These were estimated due to the availability of accurate information and because few assumptions had to be made. Probability factors were used for certain factors for each benefit to calculate a risk-adjusted external benefit. The external benefits are:

▪ Web Access

The benefit to the customer arises from the availability of program information and accurate data over the internet. The benefit was measured as a reduction in the travel time to the farmer. As the information would be available over the internet, the farmer would no longer need to travel to the Service Center to obtain the same information.

The original data points were obtained from the USDA Business Case. The percentage of farmers with internet access was updated. According to USDA Economic Research Service (ERS), approximately 40% have access to the web. For the benefit calculations, it was assumed that half of the farmers with web access would make effective use of the web access. Moreover, the salary of the average farm laborer was used. Through discussions with ERS staff, actual farmer net income varies widely and is difficult to estimate. As some farmers use outside resources to manage their farms, the cost of the average farm laborer was considered a conservative estimate of what a farmer would be willing to pay to have someone help manage a farm. As seen in Table F-6, the net result is an external benefit of nearly $6 million annually.

Table F-6. Benefit from Web Access

Number of Contracts	3,455,137
Average Time Savings per Contract	0.75
Percent of Farmers using the Internet	20%
Net Time Savings	518,271
Average Farm Laborer Salary	$23,712
Customer Benefit	**$5,908,286**

▪ Quicker Payments

With GIS technology, it is possible for customers to more quickly receive payments from the USDA, as the USDA has quick and easy access to land information. For some customers, it is anticipated that GIS could reduce the time to process payments by 12 days. The benefit to the customer was quantified as the value of money over this 12-day period. The original data points were obtained from the USDA Business Case. The interest rate used was reduced to 6%. Table F-7 details the estimation of this benefit.

Table F-7. Benefit from Quicker Payments

USDA Payments	$4,760,000,000
Percentage benefiting benefit	10%
Market interest rate	6%
Improvement factor (12/365 days)	0.0329
Customer Benefit	**$938,959**

▪ USDA Partners

Other local state and county offices will benefit when Service Centers have GIS. Osage County, Kansas performed a study detailing several areas where state and county offices could achieve time savings if Service Centers had GIS (as referenced in the USDA Business Case). The benefit was conservatively estimated on the assumption that only one state or county office would benefit from improved GIS functionality for each five Service Centers that have GIS. Table F-8 details this benefit.

Table F-8. Benefit to USDA Partners

Annual Savings per Osage County Study	$17,000
Number of Service Centers	2700
Partner Offices Benefiting	540
Customer Benefit	**$9,180,000**

- **Improved Watershed Protection Plan**

With GIS, the USDA can improve the quality of water quality studies since it will have access to better and more accurate information (to determine the delivery rate of certain pollutants on reservoirs, etc.). The USGS conducted surveys to determine the value of improved watershed plans. The benefit calculation outlined in Table F-8 is based on the USGS' interview report on the Rennsselaer County, New York watershed protection plan.

Table F-9. Benefit from Improved Watershed Protection Planning

Annual benefit per watershed	$5,280
Number of watershed plans done per state per year	4
External Benefit	**$1,056,000**

Appendix G: Acronyms

3G	Third Generation Wireless
4GL	Fourth-generation Languages
AES	Advanced Encryption Standard
APFO	Aerial Photography Field Office (FSA)
ARR	Accountant's Rate of Return
BCR	Benefit Cost Ratio
BPR	Business Process Reengineering
CASE	Computer Assisted Systems Engineering
CBA	Cost Benefit Analysis
CCC	Commodity Credit Corporation
CCE	Common Computing Environment
CD	Conservation Districts, Compact Disk
CDW	Corporate Data Warehouse
CLU	Common Land Unit
COGO	Coordinate Geometry
COTR	Contracting Officer's Technical Representative
COTS	Commercial Off The Shelf
CST	Customer Service Toolkit
DEM	Digital Elevation Model
DOQ	Digital Orthophoto Quadrangles
DOQQ	Digital Othophoto Quarter-Quadrangle
DOS	Disk Operating System
DSL	Digital Subscriber Line
EAI	Electronic Access Initiative
E-FOIA	Electronic Freedom of Information Act
FGDG	Federal Geospatial Data Committee
FIPS	Federal Information Processing Standard
FOCS	Field Office Computing System
FSA	Farm Service Agency
FSS	Federal Supply Schedule
FTP	File Transfer Protocol
GAO	General Accounting Office
GFI	Government Furnished Information
GIA	Geospatial Information Architecture
GIS	Geographic Information System
GPEA	Government Paperwork Elimination Act
GPRA	Government Performance Results Act
GPS	Global Positioning System
GSA	General Services Administration
GUI	Graphic User Interface
HTML	Hypertext Markup Language
IEEE	Institute of Electrical and Electronics Engineers
IMU	Inertial Measurement Units
IO	Interoperability
IRR	Internal Rate of Return
IT	Information Technology
ITMRA	Information Technology Management Reform Act
ITU	International Telecommunications Union
ITWG	Information Technology Working Group

LAN	Local Area Network
LANDSAT	Land Remote-Sensing Satellite
LIDAR	Light Detection and Ranging
MAP	Mapping Analysis Program
MrSID	Multi-Resolution Seamless Image Database
MS	Microsoft
NAPP	National Aerial Photography Program
NCGC	National Cartography and Geospatial Center
NCSS	National Cooperative Soil Survey
NDOP	National Digital Orthophoto Program
NIST	National Institute of Standards and Technology
NLP	Natural Language Processing
NPV	Net Present Value
NRCS	Natural Resource Conservation Service
NRI	National Resources Inventory
O&M	Operations and Maintenance
OCD	Office of Community Development
OCIO	Office of Chief Information Officer
OMB	Office of Management and Budget
PDA	Personal Digital Assistant
PKI	Public Key Infrastructure
QA	Quality Assurance
QC	Quality Control
RBS	Rural Business Cooperative Service
RD	Rural Development
RDP	Remote Desktop Protocol
RDBMS	Relational Database Management System
RHS	Rural Housing Service
ROI	Return on Investment
ROR	Rate of Return
RUS	Rural Utilities Service
SCI	Service Center Initiative
SCIMS	Service Center Information Management System
SCMI-IT	Service Center Modernization Initiative Information Technology
SDE	Spatial Database Engine
SGML	Standard Generalized Markup Language
SOAP	Simple Object Access Protocol
SSURGO	Soil Survey Geographic Database
USDA	United States Department of Agriculture
VPN	Virtual Private Network
WAN	Wide Area Network
WTS	Windows Terminal Server
XML	Extensible Markup Language

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