Geographic Information System
Development Plan
Executive Summary

Submitted to:

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Background of the study

The National Context

Many state government agencies across the United States have active geographic information system (GIS) programs and are using GIS technology beneficially to fulfill their responsibilities in many areas. A recent count showed that nearly 30 states have established formal plans or programs to coordinate statewide development of geographic information systems (GIS), and many other states are currently investigating or developing such plans.

The West Virginia Study

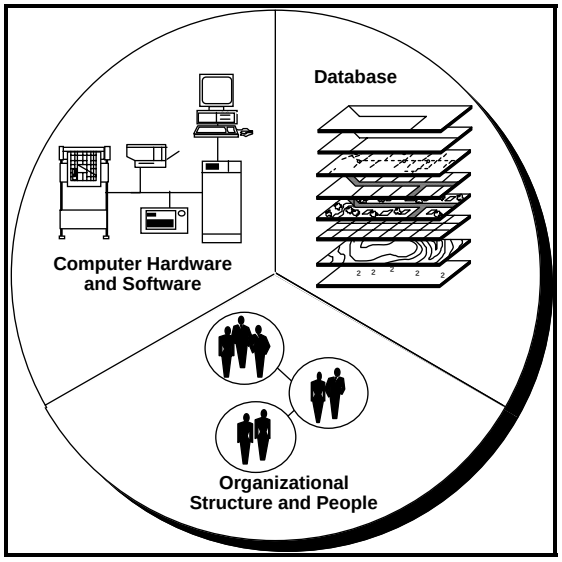
In 1992, the State of West Virginia engaged the services of PlanGraphics, Inc., to formulate a long-range plan for the development of geographic information systems (GIS) in West Virginia state government.

Through direct interviews and written surveys, PlanGraphics gathered information from many organizations in the state that are current and prospective users of GIS, as well as from other organizations that could have a role in GIS development in West Virginia. The information thus gathered serves as a basis for the recommendations the firm has put forth.

This *Executive Summary* gives a short overview of the findings and recommendations of PlanGraphics' study.

GIS in brief

Concepts



A geographic information system is a computerized system for managing all types of information that can be related to a location on the face of the Earth. Data associated with property tracts, counties, special districts, road segments, addresses, or other locational indices are all considered "geographic information." The GIS (which includes the geographic database, the computer hardware and software, and the people who manage them) can be used for simple mapping, or for more complex queries and analysis. The potential uses, or applications, of GIS in West Virginia are many and varied.

The Importance of Geographic Information

In a very real sense, the majority of state government agencies (as well as local governments and regional agencies) depend on geographic information to carry out their missions effectively. There are several key programmatic themes that are the focus of GIS needs in state government agencies. Programs in environmental planning and regulation, transportation planning and engineering, economic development, and emergency management all depend on geographic information and can use the capabilities of GIS to yield greater efficiency and quality.

Applications

GIS applications will be developed to generate information (e.g., screen displays) or physical products (e.g., map plots, tabular reports) that support one or more of the land-related activities of organizations in the state. A basic part of PlanGraphics' study was to identify and categorize GIS applications that will support the land-related activities of project participants. The following are examples of potential applications:

- Standard map update and production (e.g., county highway maps)
- Custom maps (e.g., land-use maps)
- Special suitability analysis (e.g., site suitability for sanitary land fills)

- Support for permit review (e.g., water discharge to mining permits)
- Planning studies (e.g., transportation or disaster planning).

Some applications are of higher priority than others—but they all share an orientation to the geography of the state of West Virginia.

Potential benefits of a West Virginia GIS

PlanGraphics' study showed that many ongoing programs in state agencies are land-related and can benefit tremendously from the development and implementation of a statewide GIS. A properly managed geographic information system can enable its users to derive both quantifiable and intangible benefits.

Quantifiable Benefits

Estimates of *quantifiable* benefits can be predicted based on predetermined measurable criteria, and reported as monetary savings or labor reduction. Quantifiable benefits include more efficient performance of tasks and assignments. Use of GIS software capabilities, along with an up-to-date database, results in significant gains in staff productivity in gathering, using, and retrieving geographic information. There is also a great potential in using GIS to reduce costs of outside contracts that involve collection or analysis of geographic information. GIS also provides a means for cost-avoidance by providing new capabilities and efficiencies that otherwise would require more staff or outside costs.

Intangible Benefits

Intangible benefits are not measurable because they are unpredictable (e.g., the ability to respond more quickly and more effectively to emergencies), or because their worth in dollars or labor cannot be measured with any reliability (e.g., improved public image). Even though they cannot be quantified, these and related benefits can be quite important—perhaps in the long run outweighing the significance of quantifiable benefits.

Cooperation

Perhaps the greatest overall benefit of GIS technology is the cooperation among traditionally independent agencies that it requires. Cooperation and information sharing among diverse agencies does not automatically result from a study concluding that better service would result. However, in many cases, forward-looking individuals can use the GIS project to inspire the joint planning, pooled resources, and enhanced inter-agency communication that are necessary to make the potential benefits a reality.

Overall Justification

The basic and compelling reasons to develop and operate a statewide GIS are to eliminate inconsistent and duplicative handling of geographic information, and to create a mechanism that can deliver the information to users quickly and in the desired format.

GIS development can and should be considered analogous to major capital projects undertaken by public agencies. As in a capital improvement project, funds allocated for GIS development are an investment in the future. This idea is consistent with the concept of an “information infrastructure” promoted by many experts. As part of an “information infrastructure,” GIS is analogous to utility or transportation infrastructure—its purpose is to provide a mechanism to deliver a service or a commodity to users. Looking at GIS in this context puts a focus both on the physical side of the

system (the computer hardware, software, and data communication lines) and on the commodity being delivered—the data or information.

The elements of a GIS for West Virginia

There are three essential elements that must be addressed in planning a GIS:

- The database: What information will the GIS contain?
- The system itself: How will it be configured?
- Organization: How will the GIS be managed?

PlanGraphics examined each of these areas and made recommendations to West Virginia at a functional or conceptual level.

The West Virginia Database

Map information...and more

A GIS database may be seen as a series of map overlays, or "layers" (see Figure 2). Each layer includes a set of map features along with information about those features. Text or statistical information *about* map features is stored and linked to the map layers in the form of tabular "attribute" files. For example, a map feature that represents a road could have linked attribute files that tell when a segment of the road was last paved or marked.

Recommended West Virginia GIS database

To best serve the varied requirements of West Virginia participants, PlanGraphics recommends a database that is in two parts: 1) a core set of map layers and associated attributes that many agencies routinely use, and 2) independently maintained databases that can be linked with the map layers for a specific analysis.

Database Tier Concept

Because this project includes a wide variety of participants, each with different types of land-related activities, PlanGraphics also recommends that the database be organized by level of detail in four "tiers": local, subregional, regional, and statewide. This organization of the data will efficiently balance the trade-offs of data content, map accuracy, and geographic coverage that impact all land-related activities (Figure 3).

Figure 3: Tier diagram, Fig. 2-3 from 448.4

System Configuration

Overall Assumptions

Several precepts guided PlanGraphics in the design of the system configuration. It is important that the GIS allow for communication and data exchange among sites that are scattered around the state. The design must take into account existing use of GIS by state government departments, and universities, and other organizations (including regional councils, local governments, and private companies). Because the technology itself is changing, the GIS should be developed in a way that will provide the greatest flexibility in growth and upgrade.

A central theme guiding system development is incremental expansion, and PlanGraphics recommends that West Virginia avoid acquiring a large amount of hardware and software in early phases and instead concentrate on putting in place a sound organizational structure, detailed technical design, database development, and the development of key applications.

Recommended System Configuration: A Distributed Network

PlanGraphics recommends a system configuration that is physically distributed but centrally managed and coordinated. This would include a combination of stand-alone GIS workstations and local area networks in Charleston and Morgantown and at other locations around the state. One site (West Virginia University at Morgantown) should be a service center for users needing copies of digital data or hard copy products to be generated from the GIS. User agencies' workstations will enable them to conduct their GIS processing locally, and they will have access to the common database through a data communications network.

This arrangement will encourage and support GIS development by local government agencies and Regional Planning and Development Councils.

Organizational Structure

Developing a successful GIS means facing institutional challenges in addition to technical ones. Management and organizational issues demand a great deal of attention in the early phases of system planning.

For example, what is the proper role and placement of GIS management? How should the GIS activities of state government agencies be directed, and how should they be coordinated with outside organizations? What process will be followed for collective policy decisions and consensus building at senior levels of state government? How is the system to be routinely managed and operated? How will costs be allocated among participants?

PlanGraphics recommends an organizational structure that will address these and related organizational questions (Figure 4).

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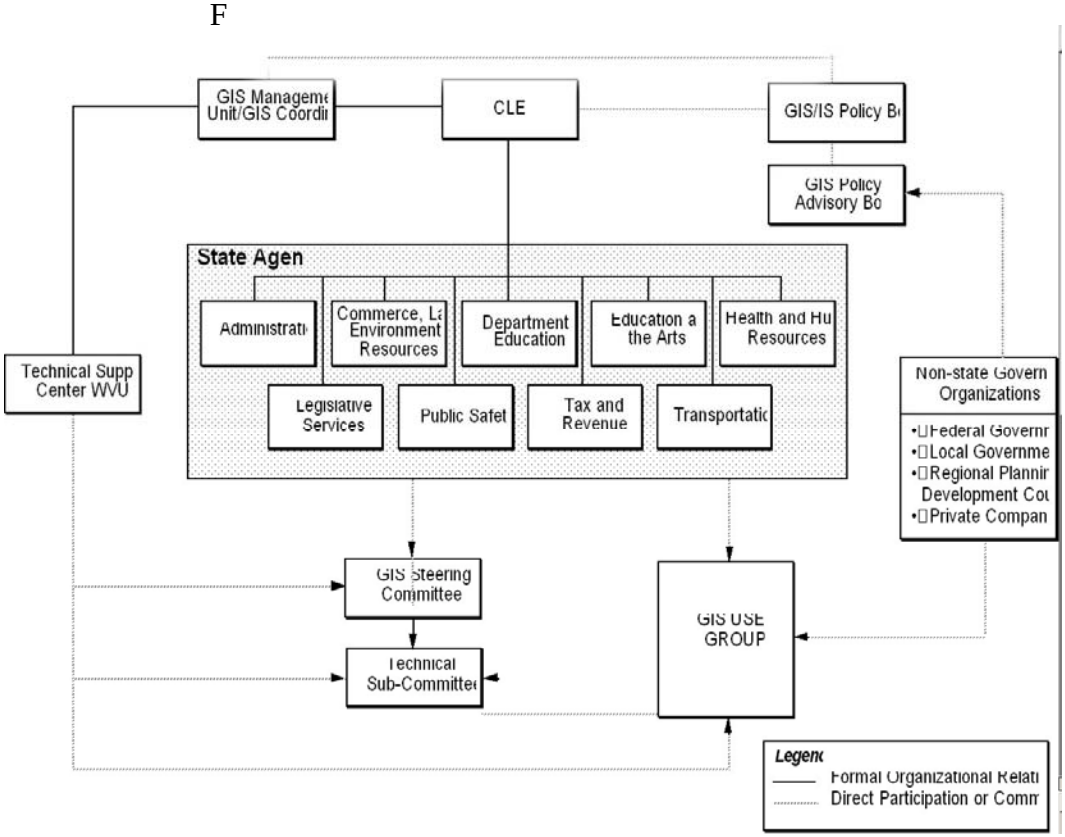

Fig. 2-5, from 448.4

Recommended Organizational Structure

Based on an evaluation of management approaches, PlanGraphics recommends that West Virginia develop an organizational structure that has the following key components:

- **GIS Policy Body**: a state government body with representatives from all state government agencies that are key participants in the GIS.

- **Management Unit**: We recommend that the state establish a full-time GIS Coordinator position. As the system develops, the state should establish a formal GIS Management Unit with necessary staff to handle the ongoing operation of an expanded GIS.

- **Technical Support Center**: This Center, at West Virginia University, would provide support in technical areas of system development and operation.

- **State GIS Steering Committee**: PlanGraphics recommends that the state establish a formal GIS Steering Committee that would be based on the informal Steering Committee now established. This Committee would deal with important issues of a technical nature or problems and concerns involving inter-Departmental coordination.

- **Technical Sub-committees**: On an as-needed basis, the GIS Coordinator or the Steering Committee may establish time-limited technical sub-committees to investigate any technical issues and provide results and recommendations for action.

- **External Organization Policy Advisory Body**: The involvement of non-state government organizations is essential for the long-term success of the GIS program.

- **GIS User Group**: The purpose of this User Group is to provide a forum for GIS users in the state to share ideas, technical accomplishments and solutions, technology news, and information that helps maintain a collective atmosphere for GIS development and operation. This User Group would evolve from the current West Virginia GIS Coordinating Committee, and all members of the WVGISCC would become part of this group.

Proposed plan and schedule

Implementing GIS takes time and a coordinated effort. The development plan that PlanGraphics recommends comprises five tracks, each a set of logically related activities:

Pilot Projects

PlanGraphics recommends that West Virginia state government conduct pilot projects to iron out approaches to GIS database development and to demonstrate GIS technology.

Organizational and Administrative Development

This set of activities includes tasks that relate to building an organizational structure, formalizing relationships between state government agencies and outside organizations, and addressing important staffing and administrative issues in GIS development and operation.

Database Development

This set of activities encompasses all tasks that involve the design and development of the GIS database with a strong focus on the adoption of standards allowing easy information exchange. Full use of the GIS is dependent on development of a GIS database covering the entire state, and it is important that West Virginia move ahead on database development as quickly as possible.

System and Application Development

This set of activities includes all tasks that relate to the specification, acquisition, and set-up of hardware, software, and communications systems, as well as the design and development of GIS applications.

System Promotion and Coordination with Outside Organizations

Tasks in this track involve internal promotion and education and activities that involve building relationships and establishing agreements with communities of interest inside and outside of West Virginia, including the distribution and sale of GIS products and services.

Phased Development

The tracks identified above are logical groupings of activities, many of which will occur concurrently. Chronologically, GIS implementation will occur in developmental phases, centered on key milestones in the implementation process.

Some state agencies, university groups, and private companies that have participated in the West Virginia GIS planning process have been conducting GIS activities for several years. This experience with the technology is a sound basis for proceeding with a coordinated statewide approach to GIS. These current GIS activities should certainly continue as a firm organizational

foundation is established for a long-term, multi-organizational GIS program.

Phase 1: Detailed Design/Initial Development

Phase 1 will begin in mid-1993 and will last approximately 18 months. Its purpose is to lay a strong technical and institutional foundation for the GIS and detailed development to be initiated in Phase 2.

Phase 2: Continued Development and Early Operation

In Phase 2, which will last approximately two years, operating procedures for accessing and exchanging GIS data will be put in place, and GIS capabilities will be expanded to all major state agencies with high-priority GIS applications. A critical objective of this phase will be completion of the GIS database layers needed to support high-priority applications and the development of key applications.

Phase 3: Expanded Operation

This phase will also last approximately two years. During this period, all high-priority applications will be developed and all database development work for GIS layers needed to support high and medium priority applications will be completed. During this phase, there will be significant expansion of GIS capabilities to many organizations in the state.

Phase 4: Mature Operations

Phase 4 is open-ended and describes a period of continued GIS expansion during which additional applications and users are added to the system.

Cost estimates and funding approaches

Cost estimates

GIS development and coordination requires a commitment of sufficient resources. PlanGraphics' cost projections for GIS implementation over the next five fiscal years is as follows:

FY 1993–1994	$470,000
FY 1994–1995	$1,137,500
FY 1995–1996	$1,177,500
FY 1996–1997	$1,322,500
FY 1997–1998	$1,322,500

These estimates include hardware, software, and database costs, and costs for the GIS Management Unit staff, but they do not include estimates for staff in user departments. Departmental staff costs are estimated at $170,000 in the first fiscal year with an increase to $280,000 in the second fiscal year, to a base amount of $340,000 ongoing. In many cases, the actual new expenditures for GIS staff will be less, as existing staff may either be performing these functions or could be cross-trained to carry out the duties, so that new hires will not be required.

Funding Approach

PlanGraphics strongly recommends that a base level of funding be allocated by the state. The base funding would support GIS Management Unit staff, the Technical Support Center at West Virginia University, and some portion of the core database development. From this initial base funding, individual Departments and Divisions should carry out detailed planning and examine ways that funds and existing resources (staff and equipment) can be devoted to GIS development and operation activities.

West Virginia should also identify and actively pursue outside funding sources and cooperative agreements with the federal government and partnerships with the private sector to provide a broader base of funding to support database development. There are many potential opportunities, and the likelihood of capitalizing on those opportunities is largely related to the willingness, energy, and creativity with which the state pursues them.

Other financing approaches—bonds, tax levies, special fees, or assessments—should also be considered by West Virginia.

Finally, PlanGraphics strongly recommends that West Virginia examine the legal issues impacting product/service sales. Once the legal setting is established, the state should begin to develop a program for partial cost recovery through the sale of special products, on-line access to data, and subscriptions to the database.

Conclusion

This GIS study has revealed that there is great interest in GIS in West Virginia, and large potential benefits to be realized. In many cases, there are GIS activities already underway in state agencies and many of the other participants agencies. The development plan provides a framework for efficient GIS development that will minimize overall costs while maintaining a level of coordination that is vital for an effective long-term GIS program across the state.