

Chapter 1 Introduction and Background

Many sectors of society now use geographic, geospatial or spatial information (GI) and related information technology (GIT) to more effectively make decisions and manage operations to meet their missions. The continuing expansion, convergence and widespread availability of GIT capabilities in geographic information systems (GIS), remote sensing, the global positioning system (GPS) and related technology promise to accelerate applicability and benefits to an ever greater array of applications and policy needs. However, research and anecdotal evidence show that policy and institutional matters have a growing influence on the implementation and use of GIT.

1.1 Project Need and Description

State Forestry Organizations (SFOs) have a unique and critical role in the nation's governance. They serve in public land management, private land regulation, wildland fire management, and additional roles to address many of society's fastest growing concerns and needs. While their significance is growing due to these roles and the increasing impact of forestry on other matters of societal importance, the nation's SFOs also have a rich heritage of working with and learning from each other to better direct and manage their operations. At the same time, SFOs share one of the strongest and longest term relationships with the federal government of any state government function.

Many SFOs have a long track record of innovation, particularly regarding data management and technology adoption to meet their missions. Some SFOs were among the earliest state government GIT users (Warnecke and Decker 2002). Today, some SFOs are among the most extensive GIT users of any agency in some state governments. However, like many other governmental entities, SFOs are challenged by expanding technological capabilities and several policy, institutional and technological issues and financial constraints.

This situation extends to all GIT, but is particularly evident and pervasive given many new and future remote sensing capabilities and opportunities.

State foresters, as the leaders of SFOs, must work with elected officials, state policy makers, internal staff, other agency directors and staff, federal counterparts and other stakeholders to best accomplish their missions. Several state foresters indicate that GI/GIT is an invaluable resource to understand, communicate, work with others and make effective decisions about conditions on the ground. They indicate that the unique capability to integrate otherwise often disparate information is particularly helpful. However, several challenges remain to make the best use of and realize the greatest benefits from these investments.

This context led to the establishment of a project, entitled ***Technology and Policy Aspects of Applying Remote Sensing in State Forestry Organizations***, to help state foresters and others learn more about opportunities and from each other to address growing needs concerning GIT, and particularly remote sensing. Funded by the National Aeronautics and Space Administration (NASA), the project is headquartered at the State University of New York's College of Environmental Science and Forestry (SUNY-ESF). The project is comprised of two separate but interconnected parts, the first addressing important technical issues associated with the application and accuracy of remotely sensed data, and the second focused on policy and institutional matters associated with remote sensing and other GIT adoption. This report is an intermediate product of the project, particularly the initial investigation into institutional and policy aspects of the use of remote sensing and other GIT by SFOs. The terminology used throughout the report is defined in **Figures 1-1a and 1-1b**.

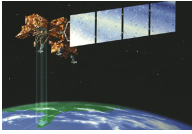


Figure 1-1a. Report Terminology

Aerial photography – A form of photography taken from an aircraft using specialized cameras and mounts. Infrared aerial photography uses special film sensitive to invisible wavelengths of electromagnetic energy that are slightly longer than but very similar to visible wavelengths. These infrared wavelengths are very indicative of the presence and condition of vegetation, but have no direct relationship with heat or thermal characteristics.

Digital aerial data – A computer representation of imagery acquired from an aircraft. This type of data is produced either by digitizing aerial photographs or through direct acquisition by electronic sensors such as digital cameras or Forward Looking Infrared (FLIR) thermal imaging sensors. Common examples include digital orthophotos, digital ortho quadrangles (DOQs), and quarter quadrangles (DOQQs).

Digital elevation model (DEM) – A computer representation of terrain that provides elevation values for a series of features, usually points or cells.

Digital orthophoto, digital ortho quadrangle (DOQ) or quarter quadrangle (DOQQ) – A computer representation of an aerial or satellite image that has been processed to remove displacements of points caused by sensor tilt, topographic relief, or perspective geometry. These processed images have a consistent scale and can be used much like a map. A common example is the digital ortho quarter quads (DOQQs) produced in the U.S. for each quarter of a standard 7.5 minute U.S. Geological Survey quadrangle map.

Geographic or geospatial information (GI) – Information about a phenomenon that can be referenced to a specific location relative to the earth's surface.

Geographic information system (GIS) – A computer system that is capable of assembling, storing, manipulating, analyzing, and displaying geographic or geospatial information. GIS also can be considered to encompass the broader resources required for these activities, including computer software, hardware, data and personnel.

Geographic or geospatial information technology (GIT) – A broad term encompassing all forms of technology to gather, display, sample and process geographic or geospatial information, in particular including GIS, remote sensing and use of the global positioning system.

Global positioning system (GPS) – A system operated and maintained by the U.S. Department of Defense that is based on a constellation of satellites maintained in precisely known orbits about the earth. Ground-based electronic receivers determine locations (coordinates) on the earth's surface using information radioed from multiple satellites that are in view of the receiver.

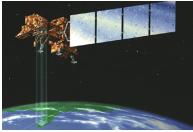


Figure 1-1b. Report Terminology

Light Detection and Ranging (LIDAR) System – An instrument capable of measuring distance and direction to an object by emitting timed pulses of light in a measured direction based on the time between when a pulse is emitted and when its echo is received. Three-dimensional information is computed by relating these distance and direction measurements to the location and orientation of the instrument. Airborne LIDAR instruments are used to develop three-dimensional data such as digital elevation models (DEMs), tree and building heights, and feature geometry.

National Digital Orthophoto Program (NDOP) – A program jointly proposed in 1990 by the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service and Farm Service Agency and the U.S. Geological Survey (USGS) to ensure the availability to the public domain of photography, imagery and digital orthoimagery data. NDOP coordinates with the National Aerial Photography Program (NAPP) to provide imagery such as digital orthophoto quadrangles (DOQs) data that meet national requirements.

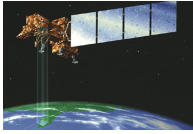
Radio Detection and Ranging (RADAR) – An instrument that emits a narrow beam of electromagnetic pulses (radio waves) in a specific direction and measures the time, intensity, or other characteristics of the energy that returns from targets or objects. RADAR imagery can be obtained at night or through clouds and smoke. RADAR images provide a very unique visual impression and advanced analysis of RADAR imagery usually requires specific experience, knowledge, and facilities.

Raster – An approach for representing and organizing space by subdividing a region into a regular pattern of cells (or pixels) that completely cover the region. Usually, square cells provide a grid of values for the condition or variable of interest. Digital imagery is a common example of raster data where cells contain values that represent different shades. See also Vector.

Remote sensing (RS) – Process of determining properties of objects without contact, usually by measuring and recording images based on electromagnetic energy that has interacted with the objects. Remote sensing also involves the manipulation of images to derive useful information. Remote sensing traditionally involves aerial photography but now includes many electronic sensors on both airborne and space-based platforms.

Satellite sensor – A remote sensing device that measures, images, receives, and transmits data from an orbital path above the earth.

Vector – An approach for representing and organizing space by subdividing a region based on points, lines, and polygons that delineate where conditions change. The points, lines, and polygons are defined using ordered lists of coordinate pairs. See also Raster.



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Overall project direction is provided by Dr. Paul Hopkins, Professor at SUNY-ESF, who also manages the technical investigation. Additional project guidance is provided by the National Association of State Foresters (NASF), its member state foresters, and particularly its Research Committee chaired by Mr. Gerald Thiede, State Forester of Michigan. The policy and institutional component of the project is managed by GeoManagement Associates, Inc. and primarily conducted by Dr. Lisa Warnecke. Important assistance is provided by Dr. Zorica Nedovic-Budic, an Associate Professor at the University of Illinois at Urbana-Champaign, and Mr. Ronald Nanni and Mr. William Stiteler IV, SUNY-ESF graduate students.

The policy and institutional part of the project includes complementary research and outreach focused on the following goals:

1. Establish working relationships with and gather continuing input from NASF, state foresters and their staffs, and other related organizations;
2. Gather, synthesize and analyze information about remote sensing and other GIT approaches and use in the 50 SFOs; and
3. Understand and communicate key policy and institutional issues concerning remote sensing and other GIT in SFOs and related organizations.

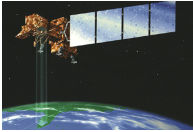
This document serves as an interim report for the policy and institutional part of the project. It provides an initial baseline understanding about how the nation's SFOs approach and apply remote sensing and other GIT, and begins to identify associated policy and institutional issues and challenges. The information and analysis provided in this report are designed to be informative for state foresters, their staff and others working with them. However, the results are also useful for others addressing policy and institutional issues related to remote sensing and GI/GIT adoption as implications are relevant for

many other organizations. The results of this analysis will also be used in the second portion of the project's policy and institutional work. It will be used to help design and implement a follow up survey instrument to refine findings and further investigate conditions to identify issues, benefits, pitfalls, needs and lessons learned. This work will be used to generate suggestions and recommendations for future actions to address these concerns.

1.2 Forestry Characteristics Among the 50 States

Forestry has long been and will likely always be a worldwide, societal concern - with appropriate attention by government policy makers. Early focus concentrated on meeting demand for forest resources to meet societal building needs balanced with conservation values. Today and future challenges add recognition of the unique and high importance of forested lands to maintain and improve many aspects of conditions on the Earth. For example, much of the world's potable water (two thirds of the supply in the United States) originates in forests, and diminishing water quality is of growing concern. Increasing trends, such as forest fragmentation, can exacerbate problems and increase the urgency for attention and action.

The challenges and associated tradeoffs facing forestry and other policy leaders and interests are growing as never before. For example, the U.S. Forest Service (USFS) located in the Department of Agriculture, which is the largest forest land management organization in the country, operates with more and sometimes conflicting Congressional directives than any other federal land management agency (National Academy of Public Administration. 1998). Recent extensive changes in the ownership of industrial forested lands, growing pressures on the nation's many non-industrial land owners, and the growing activism of various



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stakeholders in the U.S. also reflect the importance of forestry and associated challenges.

States, and their governments, vary considerably in terms of forestry, as for many functions of government. The overall land mass of the states and the relative amount of forested land within their borders differs dramatically. The most recent data available from NASF, the report

entitled *State Forestry Statistics - Fiscal Year 1998 Report*, provides detailed data about conditions in each of the 50 states and SFOs except Alaska (Dupree 1998). For example, summarization of these data as shown in **Figure 1-2** reveal that forested land ranges from just over 300,000 acres in Delaware to over 39 million acres in California, and from 1.17% of a state's land mass in North Dakota to 89.67% in Maine.

Figure 1-2. Total and Forested Land Mass by State - Descriptive Statistics (in millions of acres)

	N	Range	Minimum	Maximum	Sum	Mean
Total	49	171.12	0.68	171.80	1891.38	38.60
Forest	49	39.30	0.37	39.67	608.00	12.41
% Forested	49	88.50	1.17	89.67	-	42.03

Source: State Forestry Statistics - Fiscal Year 1998 Report (Dupree 1998)

As shown in **Figure 1-3**, state foresters reported that ownership of forested land is about one-fifth of federal ownership (36.96 million acres and 165.1 million acres respectively). Correlation analyses reveal that the greater the acreage of forested land, the greater the forested acreage under state ownership. State land management is one of the most critical roles of SFOs, especially in states with large land holdings.

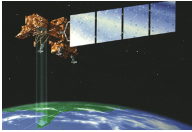
1.3 Characterizing State Forestry Organizations

While forestry is the top mission of many public and private organizations in the U.S., State Forestry Organizations (SFOs) likely have the widest range of roles, responsibilities, and activities of any type of forestry organization in the country. Approximately one third of the total

Figure 1-3. Land Ownership by State - Descriptive Statistics (in millions of acres)

	N	Range	Minimum	Maximum	Sum	Mean
State	49	4.00	0.00	4.00	36.96	0.75
Industrial	49	10.66	0.00	10.66	92.76	1.89
Non-industrial	49	17.09	0.07	17.16	306.84	6.26
Federal	49	22.80	0.00	22.80	165.10	3.37
Other	49	2.80	0.00	2.80	13.05	0.27

Source: State Forestry Statistics - Fiscal Year 1998 Report (Dupree 1998)



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land area of the U.S. is forested, but the federal government only has direct authority over lands under its management. As explained below, SFOs similarly have responsibility for lands management, but also have authority over private forested lands and manage several other forestry related programs. SFOs must balance many competing and often conflicting interests and needs in order to best direct, manage and plan for the best interest of their state's forest resources.

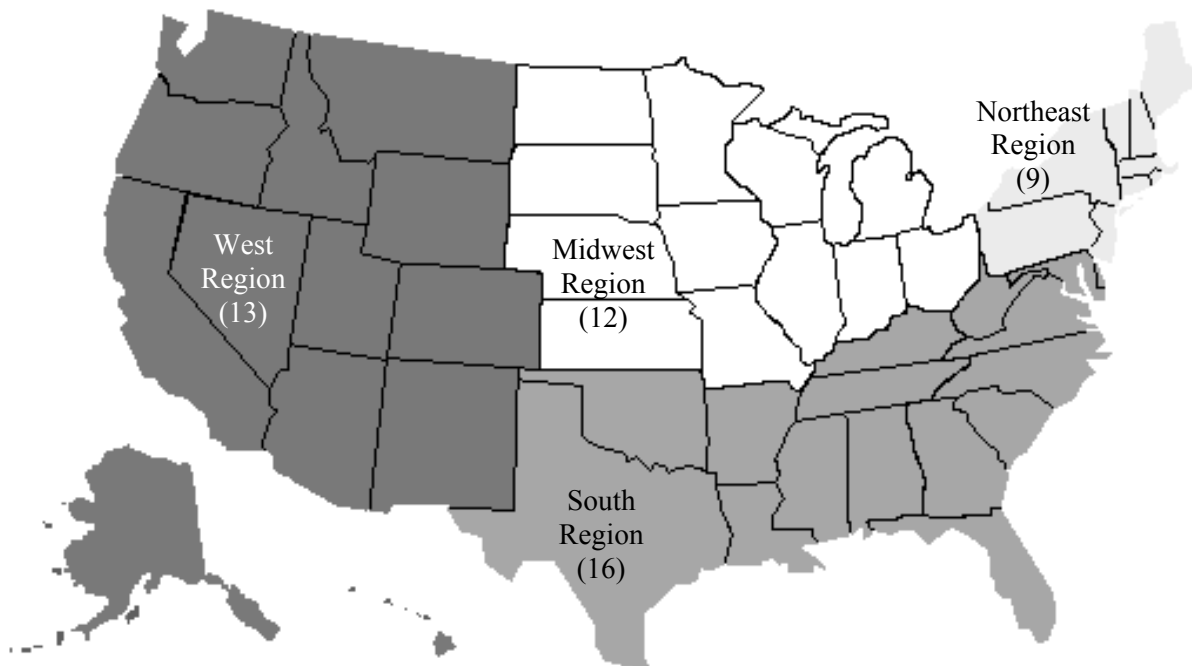
1.3.1 State Forestry Organization Responsibilities

While most SFOs are responsible for managing

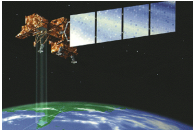
forested lands under state ownership, land management responsibilities sometimes extend beyond forested lands in some states. Analysis of state government structures and primary state land management organizations reveals that 12 (or 24%) of the SFOs also are responsible for managing non-forested state-owned lands. Moreover, almost all 48 (or 96%) of the SFOs are responsible for wildland fire management, which also extends beyond forested areas.

Efforts are made in this project to compare regional conditions and determine any relevant differences. The standard four U.S. Census Bureau regions as shown in **Figure 1-4** are used in these evaluations.

Figure 1-4. U.S. Census Bureau Regions*



* Alaska and Hawaii in West Region not drawn to scale.



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Regional differences were observed in terms of SFO roles. For example, the only two SFOs without fire responsibilities are located in the Northeast (Massachusetts and New York). However, as shown in **Figure 1-5**, two thirds of the SFOs in this region (six of nine) have responsibility for non-forested state lands in addition to forested lands (which represents half of the SFOs nationally). The Western region has the second largest number of SFOs (3) with non-forested state land management responsibilities.

Figure 1-5. SFOs with Non Forest Land Management Responsibilities by Region

	NE	MW	South	West	Total States
No	3	10	15	10	38
Yes	6	2	1	3	12
Total	9	12	16	13	50

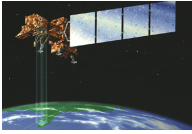
In addition to responsibilities for state owned forest land, other state lands and wildland fire management, many SFOs also have authority over forested lands owned by the private sector. State foresters indicated that almost 400 million acres are owned by the private sector, approximately ten times more than state owned and twice the number of acres of federally owned forested land (Dupree 1998). State programs directing private forest practices have increased both in number and intensity in recent decades (Ellefson, Cheng and Moulton 1995). SFOs also work with public and private forest land owners in a variety of non-regulatory programs in addition to regulatory practices. SFOs also are key participants in forest assessments and other natural resources management practices and assessments. SFOs are also becoming active in urban forestry, recreation, and economic and rural development efforts due to changing societal relationships

with and needs concerning forest resources. The functions and activities of SFOs are determined by state directives and programming, but also to respond to federal directives and funding for specific functions.

1.3.2 Organizational Placement of SFOs

The organizational placement and reporting relationship of SFOs also vary by state. Within this report, the identity of organizations within which SFOs are located is referred to as "parent" to help clearly identify these entities and reporting relationships. An organizational typology of state government natural resources and environmental organizations developed for a previous study (Warnecke 1994) was used to understand the organizational placement of the nation's 50 SFOs. As shown in **Figure 1-6**, almost half of all SFOs are located in a Natural Resources Department (21). An additional six SFOs exist under an environmental and natural resources (ENR) department or agency. These departments or agencies combine natural resources functions with environmental roles similar to the U.S. Environmental Protection Agency. Ten SFOs do not report to another state department, and exist as their own department (5) or serve under a Forestry Commission (5). The remaining less than a third of the SFOs exist as separate units within state government under either Agriculture (6), Lands (1), or Commerce (1) departments, or operate under their state's public university system (5).

Some regional differences can be observed when considering the organizational placement of SFOs. For example, all five of the Forestry Commissions are located in the south. Four of the other five independent SFOs, which exist as separate departments, are located in the west where omnibus ENR organizations are less



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Figure 1-6. Organizational Placement of SFOs by Region

	Northeast	Midwest	South	West	Total
Agriculture		1	5		6
Independent			1	4	5
Commission			5		5
Commerce			1		1
Omnibus ENR	5		1		6
Lands				1	1
Natural Resources	4	8	2	7	21
University		3	1	1	5
Total	9	12	16	13	50

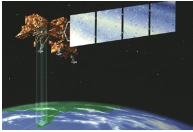
likely to occur than in eastern regions (Warnecke 1994). As shown in Figure 1-6, five of the six SFOs located in ENR organizations are in the northeast. Five of the six SFOs are located in Agriculture Departments similar to the U.S. Forest Service. The organizational placement of the remaining 28 SFOs seem to be more distributed across the regions. Overall, the organizational placement of most SFOs in the south differ from that of other regions. At least ten of the 16 southern SFOs are located in organizations that are separate from other natural resources functions, which is in contrast with the majority of states (28). Otherwise, the organizational placement of SFOs is generally spread across the regions.

1.3.3 General Resource Commitments in SFOs

Given that SFOs differ significantly in their sizes, amounts of forested and state lands, responsibilities, and organizational placement, SFOs also vary in terms of the size of their operations and their corresponding resource commitments. For example, as shown in **Figure 1-7**, expenditures by state vary from almost \$1.5 million to \$450 million, with average spending per state of about \$30 million (Dupree 1998). Total expenditures are significantly correlated with the acreage of forested land (Pearson correlation coefficient of 0.638). The findings from the NASF survey also indicate that expenditures for management are significantly

Figure 1-7. SFO Expenditures and Personnel Levels (\$1000s)

	N	Range	Minimum	Maximum	Sum	Mean
Total expenditures	49	446600	1404	448004	1447772	29546.37
Personnel w/o Temps	48	4336	19	4355	15562	324.21
Personnel w/ Temps	48	5829	26	5855	21721	452.52



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correlated with the acreage of forested land owned by the state, but the total expenditures are not, which reflects the many roles of SFOs.

The findings also reveal a great variation in the number of employees in SFOs, ranging from 19 to almost 4400 without considering temporary employees, and with an average of almost 325. As can be expected, the total expenditures are also highly correlated with the number of employees.

This information about forestry in the states and general characteristics of the SFOs is useful to help understand GIT conditions within these organizations as described in subsequent chapters.

1.4 Statewide GI/GIT Approaches

While this report focuses on the nation's 50 SFOs, most state governments have responded to the accelerating growth in GIT use by institutionalizing statewide coordination approaches for GI/GIT. While not all states have done so, these approaches typically include directives for statewide GI/GIT coordinating entities, staff and/or groups. A description of statewide GI/GIT coordination conditions in the 50 states is contained in a recent report prepared for the National States Geographic Information Council (NSGIC), an association of state GI/GIT coordinators similar to NASF for state foresters (Warnecke, et.al. 2002). The information and figures in this section are reproduced with permission from this NISGIC report.

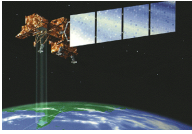
SFOs may have direct or indirect linkages with these offices and/or groups as described later in this report. SFOs can achieve several benefits by working with corresponding statewide GI/GIT coordination efforts. As explained in Chapter 6, relationships with these statewide efforts can have important impacts on GIT results in SFOs.

1.4.1 State GI/GIT Coordination Entities

State GI/GIT coordination entities typically include small offices or one or a few individuals. However, these entities can have as many as 36 staff, as in Michigan. Known in the following discussion as "coordinators" regardless of their size, specific criteria are used to determine their incidence.

Figure 1-8 reveals that 46 states had at least one state GI/GIT coordinator in 2001. Identities of these coordinators are included in each Section 3 of the profiles in Appendix C. With evaluation at several points in the past, the trend is clearly toward the existence of more statewide GI/GIT coordinators over time. An important phenomena revealed in the most recent investigation is the growing existence of secondary state GI/GIT coordinators. States with secondary coordinators are those in which statewide coordination roles are clearly shared by two separate organizational entities. Details about the 17 states with these entities were not investigated. However, most of these entities are natural resources departments (which may be SFO parents) or state-sponsored universities. Many early statewide coordinators originated in natural resources departments and some continue to serve in primary or secondary statewide GI/GIT coordinating roles today. This is likely because these departments were among the earliest users of GIT, but also because some states experienced strong efforts in the 1980s to integrate natural resources data, which often is needed by other agencies as well (Warnecke 1998).

This figure also indicates whether state GI/GIT coordinators are recognized as either official and "authorized," or more informal and "unauthorized." Over half of the states have had authorized coordinators in place for over a decade. In comparison, using a similar definition, the National Association of State



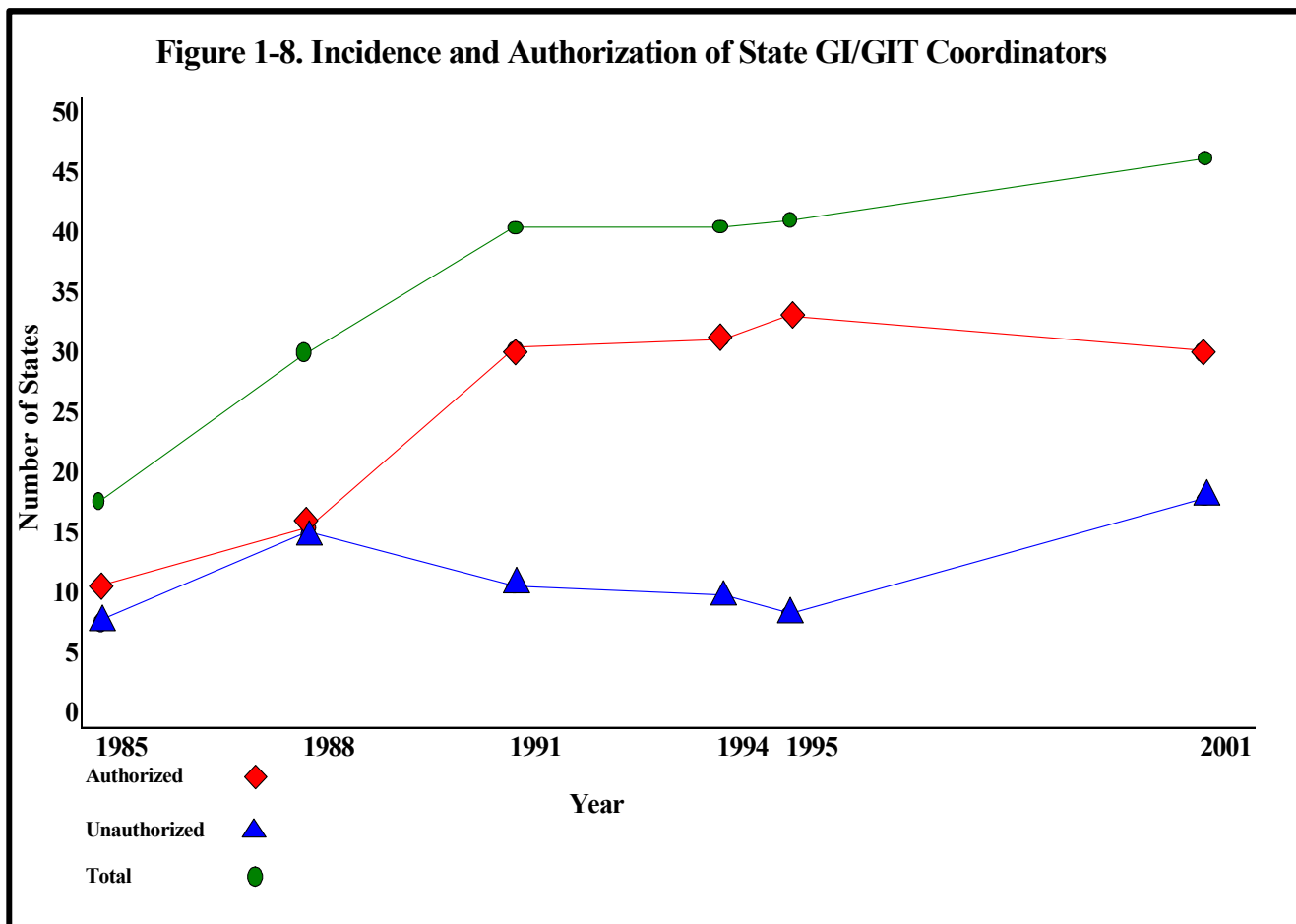
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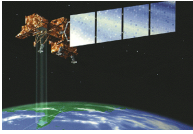
Chief Information Officers (NASCIO) found in its recent survey that 47 states have authorized general information technology (IT) management or organizations (NASCIO 2002). The number of states with authorized GI/GIT coordinators more than tripled between 1985 and 1994, revealing a trend toward increasing authorization of state GI/GIT coordinators that was even stronger over this time period than the increase in their incidence.

Despite continued growth in GIT use in states, the trend toward a growing number of authorized coordinators has diminished in recent

years. These findings likely indicate the continuing challenges of institutionalizing and maintaining policy-level support for statewide GI/GIT approaches, and at the same time, growing financial constraints shared by SFOs and others in state governments.

The findings about authorization are particularly important at this time because the majority of the states have Gubernatorial elections in 2002. Legislative authorization exists in about half the states, and another six states exist with Executive direction. Authorization and support can be important when encouraging state





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agencies to cooperate with others, or to secure and maintain resources for GI/GIT when competing with other state government functions. Legislative direction can be viewed as the most preferred and permanent form of authorization because Governors change regularly. Examples of states with Legislative direction include Virginia, Utah, Kentucky, Wisconsin, Arkansas and Arizona. The American Planning Association recently prepared a "Growing Smart Legislative Guidebook" including many examples of model legislation. Prepared with input from this lead author, the model provisions in Chapter 15 include establishment of a Division of Geographic Information and a Geographic Information Advisory Board. (http://www.planning.org/guidebookhtm/chapter_fifteen.htm) This model is not necessarily endorsed by this author or others associated with this project, but it is informative for states developing authorization language.

1.4.2 State GI/GIT Coordination Groups

State GI/GIT coordination groups have existed for over a decade in virtually all 50 states. These groups share a primary or dedicated purpose to address and improve inter-organizational conditions concerning GI/GIT among state agencies, but increasingly also with other sectors operating in their states. Some states have multiple coordinating groups that work with each other but may focus on differing technology or sectors. Other state groups and entities may impact the need for and/or complement the activities of GI/GIT groups. For example, states with omnibus or large natural resources and environmental departments may have internal data coordination groups that may obviate the need for some roles and activities of statewide groups. Some states have inter-organizational mission-driven groups (such as for homeland security, growth management, environment and natural resources, or otherwise)

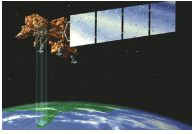
which may include data coordination as an important aspect of their work and thus also conduct GI/GIT coordination activities. **Figure 1-9** reveals the incidence and authorization of all known statewide GI/GIT coordination groups as of the end of 2001.

Leading state GI/GIT groups are identified in Section 3 of each profile in Appendix C. A total of 95 dedicated GI/GIT groups were identified to exist within 49 states. SFOs may participate in leading or other state GI/GIT groups as indicated in the state profiles in Appendix C and discussed in Chapter 6. Florida was the only state without a group (it also was one of the four without a coordinator) because it recently experienced some changes in Information Technology (IT) management that impacted GI/GIT coordination.

The remaining 49 states each had from one to four groups. Various reasons exist for states to have multiple groups. In some states, there is a clear distinction between policy level groups and those with technical focus. Both groups may exist officially, but there is a clear distinction and reporting relationship between them. Some GI/GIT groups formally or informally report to broader IT groups that also exist in most (if not all) states, while in other states there appears to be little relationship between these groups.

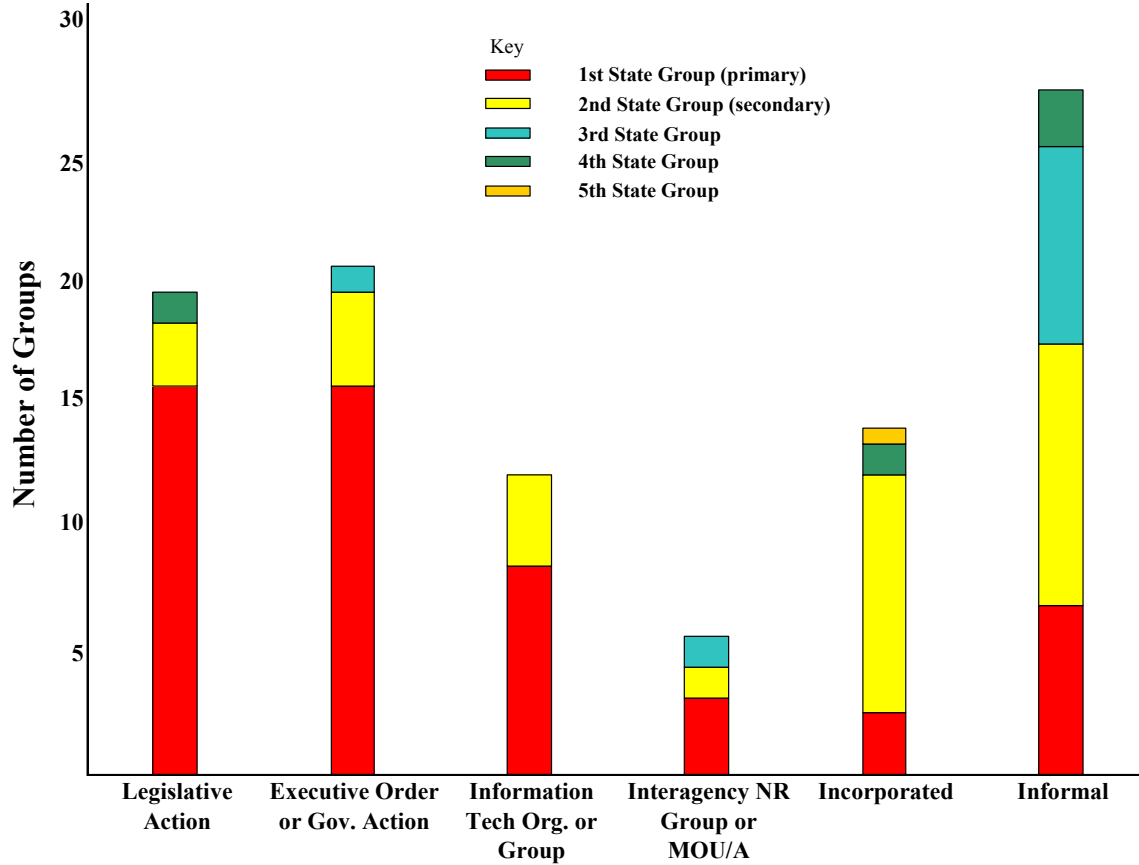
State GI/GIT groups are classified using various authorization categories. Thirty states have their leading GI/GIT coordination group authorized via Legislative or Gubernatorial action. Some state groups are classified as unauthorized, but some may be legally incorporated.

The existence of GI/GIT groups is an important component, and may serve as a critical "first step" to further institutionalization of statewide GI/GIT coordination. They have differing authorization, participants, objectives, resources and activities, but they typically share the goal of greater GI/GIT coordination and



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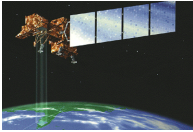
Figure 1-9. Number and Authorization of State GI/GIT Coordination Groups



associated data sharing. Participation by SFOs and other state agencies can reap internal benefits. Groups frequently build momentum and demand for data, services and specific coordination mechanisms. They also seem to increasingly have formal and informal influence over the direction of GI/GIT in their states even though their authorization varies. The increasing incidence and authorization of state GI/GIT groups reveals an overall trend toward formalization of roles and responsibilities, and generally reflect increasing maturation and institutionalization of GI/GIT in states.

1.4.3 Statewide GI/GIT Roles, Functionality and Level of Effort

Statewide GI/GIT coordination roles, responsibilities, resources, and level of effort vary significantly among the states. A state GI/GIT coordination entity can range from a portion of one employee's time to several staff. Functionality usually depends upon available and type of financial sources, with some GI/GIT coordinators concentrating on coordination roles, while others primarily operating as service centers to conduct specific work charged to others, particularly state agencies.



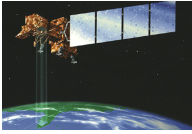
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Comparing states concerning the functions they perform and associated resource commitments is even more difficult for GI/GIT coordination than for forestry. Differing definitions are pervasive and many state GI/GIT activities, such as by SFOs and their parents, are funded as part of program missions. Moreover, each agency differs in how GI/GIT costs are categorized.

Some states have appropriated general fund or other resources for data, clearinghouses or coordinating staffs while others are financed through charge backs to users. **Figure 1-10a** provides a list of 15 statewide GI/GIT coordination functions that can be grouped into four categories, including data, coordination, assistance and other. These categories are defined

Figure 1-10a. Statewide GI/GIT Roles and Functionality

A. Data Function	
A-1	Provide data clearinghouse, access and dissemination functions for data indexed and possibly maintained in a state GI/GIT database, including customized data searches, manipulation and interpretation to meet user needs.
A-2	Develop and implement data and metadata policies, guidelines, standards and procedures to encourage data commonality and sharing, including accuracy and scale requirements to meet overall state needs.
A-3	Develop data (framework and otherwise), sometimes with general appropriation or collaborative interagency funding to ensure data is useful for more than one purpose, project or agency.
A-4	Gather information about and/or prioritize state level data needs independently or collaboratively.
A-5	Perform quality assurance, quality control, validation and arbitration of statewide data sets.
B. Coordination Function	
B-1	Serve as a clearinghouse concerning activities, projects and plans about GI/GIT in state agencies and possibly other entities, including providing directories, guides, annual reports, newsletters and other materials with current information.
B-2	Promote collaborative planning for future data development and other work, including helping prioritize and coordinate data work conducted by multiple organizations.
B-3	Provide staff support for GI/GIT coordination and users groups.
B-4	Sponsor GI/GIT events, including conferences, workshops and meetings to facilitate information exchange.
B-5	Coordinate GI/GIT with CIO and the state's IT organization(s).
C. Assistance Function	
C-1	Provide GI/GIT education or training services for state agencies and others.
C-2	Provide GIT assistance and facilitate interlocal coordination to local governments.
C-3	Provide GIT assistance and facilitate coordination to others.
C-4	Provide financial resources and/or assistance, e.g., funding, in-kind services, etc. to local governments.
D. Other Functions	
D-1	Provide contract GI/GIT services for state agencies and others.
D-2	Other.

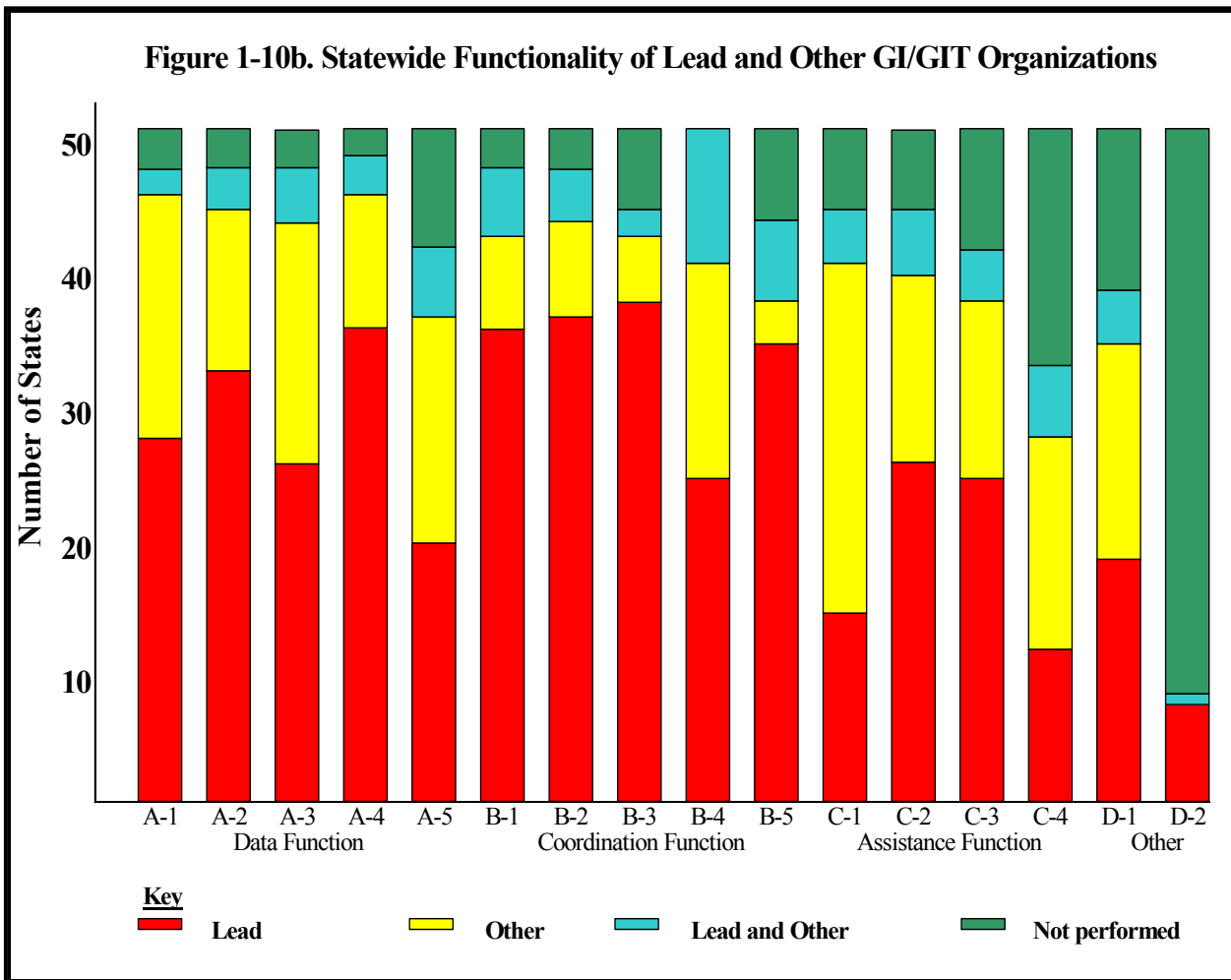


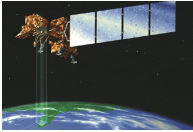
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to differentiate general coordination activities, such as educational, planning and group support work, with that of efforts specifically focused on data access and development. Assistance is considered a third distinct function, as is work conducted under contract or otherwise for a fee, such as applications projects in individual agencies. This list was provided to leading GI/GIT coordinators in the 50 states and they were asked to indicate which functions they perform. The responses are shown in **Figure 1-10b**. Important for SFOs and other agencies, these results clearly indicate that most states conduct general coordination efforts.

However, on average, only slightly more than 30 of the 50 lead coordinators conduct the data functions listed in Figure 11a. Of the three categories, the fewest number of states and lead coordinators conduct specific assistance efforts, though some states have grant programs to facilitate GI/GIT in local governments.

Financial resource commitments for statewide GI/GIT have not been measured for all 50 states. A comparative study of such commitments for 12 states is available from work conducted for the State of Ohio (Warnecke, et.al. 2001). Personnel commitments are easier to measure and provide a





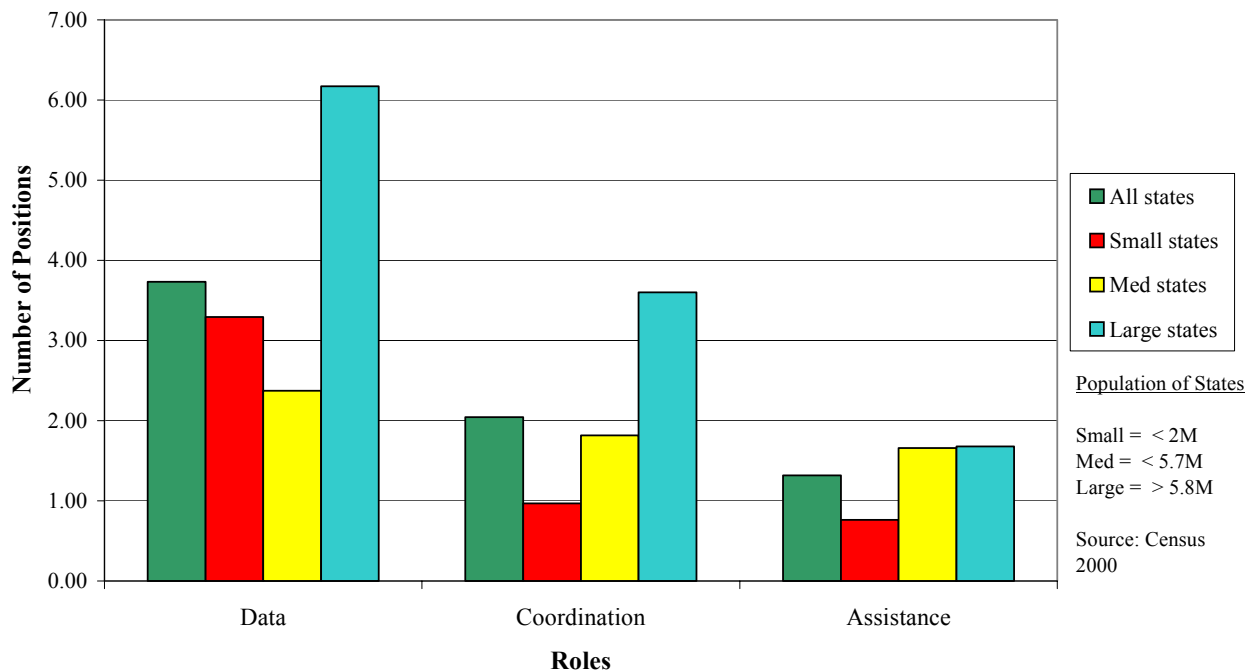
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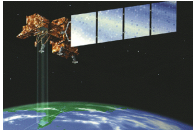
valid approach to understand general and relative resource commitments across the states. These comparisons, while less difficult than for finances, are also challenging to measure and compare because similar work can be done by individuals in a combination of different entities in one state or by a single office or individual in another. GI/GIT coordinating work can be conducted through a combination of paid and volunteer time, on the part of state employees within the GI/GIT coordination entity or other state agencies, or by others outside state government, making quantification even more difficult. Moreover, many different job classifications and descriptions are used for GI/GIT work, even within the same state and agency, such as also exists in some SFOs. This situation compounds the difficulty of distinguishing between statewide and agency level GI/GIT efforts. Some states seem to be establishing statewide classification series for

GI/GIT, but in many cases, engineers in a transportation department and resource analysts in SFOs or natural resources departments may do similar work. Some employees may not use GI/GIT directly, but coordinate, direct or support its use, so they may have another set of job titles.

Information about staffing commitments is available for all 50 states in **Figure 1-11**. Results are shown according to the same GI/GIT functions described above (data, coordination and assistance). The level of personnel resource commitments are measured in terms of Full Time Equivalent (FTE) positions. FTEs are often used to quantify staffing because one FTE may be one full time individual or the combination of two or more part time staff. Vast differences are revealed, ranging from less than one person in a few states to 36 in Michigan. An average of 8.29 FTEs per state work on all statewide GI/GIT coordination

Figure 1-11. Statewide GI/GIT Level of Effort in Full Time Equivalent (FTE) Positions





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efforts. FTE commitments for specific data, coordination, assistance and other functions reveal that the greatest number of FTEs is devoted to data efforts, and particularly in more populous states with an average of over six FTEs.

These results about statewide GI/GIT functionality and resource commitments complement the findings about coordinating entities and groups. While significant differences are highlighted among the states, these findings provide clear evidence that states are devoting resources for statewide GI/GIT coordination, and particularly to meet data needs. Increasing institutionalization and maturation of statewide GI/GIT coordination is clearly evidenced and provides many opportunities for SFOs and other agencies. Many benefits and savings can be realized in internal approaches by learning from and accessing data from others, and working with others to help finance and develop data needed to meet SFO and other agency needs.

1.5 Report Overview

This report characterizes remote sensing and other GIT conditions in each of the 50 SFOs based on information gathered from the 50 state foresters and their staff, and augmenting materials as described in the following chapters. Most of the findings presented in this report are based on "State Profiles" that are located in Appendix C of the report. State participants providing information in the project are listed in Appendix B.

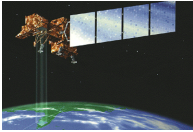
Chapter 2 provides an overview about remote sensing resources available for SFOs, including airborne and satellite products. It also includes an important description about ground reference data that is required in remote sensing, with highlights about the technical component of this overall project headquartered at SUNY-ESF.

Chapter 3 reviews the methodology of the project resulting in this report. It includes summary descriptions about related research and literature. It also describes project involvement with NASF and individual state foresters in order to ensure accurate and useful results. The chapter also includes a description of the development and content of the profiles in Appendix C and the methods employed to analyze the results.

Chapter 4 provides a summary about the growth and current presence of remote sensing and GIT in SFOs based on analysis of the state profiles. General summary statistics are provided and analyzed based on some external factors. Another important focus of the chapter is on remote sensing and other GIT applications. Information about GIT usage from the SFO profiles was classified according to 14 applications categories. The frequency of each of these applications is provided and compared for each form of GIT and type of remote sensing. Chapter 5 includes a description of each of these 14 applications categories, and examples and graphics from selected SFOs about their use of remote sensing and other GIT for these applications.

Chapter 6 includes information about how the nation's SFOs incorporate, manage and deploy remote sensing and other GIT and GI within their organizations. Comparisons and analysis are provided about organizational approaches and structure; types and distribution of data and technology roles and responsibilities; types of staff and contacts; internal and external coordination and relationships; and GIT policies, plans, issues, and benefits. These findings about current approaches and issues within the nation's SFOs provide insight about future trends and opportunities.

Chapter 7 includes information to help SFOs address some of the institutional and coordination matters raised in the report.



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Information is provided about NASA's work with states and the U.S. Forest Service's (USFS) approach to and activities regarding remote sensing and other GIT. Conclusions are also provided, including implications of the findings for SFOs and others. Appendix D augments this chapter with examples of remote sensing applications at the USFS.

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