Project Report

Wisconsin and National Framework Surveys – Comparison, Validation, and Recommendations

Submitted to the
Federal Geographic Data Committee
and
University Consortium for Geospatial Information Science

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I. Introduction

This report describes two initiatives that contribute to discussions of a follow up to the 1997-8 National Framework Survey (NFS) conducted by the Federal Geographic Data Committee (FGDC) and the National States Geographic Information Council (NSGIC). The first component is the results of a fifty state inventory of state-level surveys of geographic information system (GIS) conducted since the NFS survey. We were interested in learning what states have done, particularly if and how they are obtaining information about local-level activity. The second component is a summary of the Wisconsin experience with a web-based statewide inventory of county land information system status. The Wisconsin Land Information Program asked the University of Wisconsin-Madison Land Information and Computer Graphics Facility (LICGF) to design, develop, and implement a system for annual updates on county efforts in GIS data automation and system development. From these experiences, we include a "lessons learned" section oriented to thoughts on how a national process might be created that could track the status of local and state GIS data development. This report begins with an explanation of how goals for the project evolved over time.

The (Evolving) Scope of the Project

A project titled Wisconsin and National Framework Surveys – "Comparison, Validation, and Recommendations" was funded by FGDC, via UCGIS, in the fall of 1999. The original proposal included five goals:

1) cross-validate results of the surveys based on common elements;
2) put the NFS into a temporal sequence, supporting an interpretation of data automation status in terms of system development stages;
3) put the NFS in a social and cultural context, supporting an evaluation of Wisconsin's high response rate and advanced data development status;
4) provide a basis to extrapolate costs and benefits of framework development from Wisconsin to counties of the nation;
5) recommend methods to coordinate state-level inventories with national surveys to eliminate duplication and enhance interpretability, including evaluation of methods from Wisconsin's Internet-based inventory that may be applicable to national efforts.

In post-award discussion with Max Egenhofer and Bob Rugg (UCGIS), and Milo Robinson (FGDC), we were encouraged to reduce the scope of the project. Max relayed that the project reviewers felt the objectives could not be achieved with the level of funding provided. Milo indicated that they were interested in findings with application to FGDC needs, particularly goals 1 and 5. FGDC also indicated an interest in lessons from the Wisconsin experience that might be useful in consideration of another NFS. Through email correspondence, we indicated to the UCGIS Research Committee that we would focus our efforts on goals 1 and 5, in addition to the Wisconsin experience with a state-level survey.

A project initiation meeting was organized with these general themes – the reduced research goals and the exploration of next steps in NFS. The meeting was held near Chicago, Illinois in early February 2000. Several statewide coordinators of the NFS were invited. Leslie Pelch of Vermont and Cheryl Oliver of Illinois (also, immediate past-director of NSGIC) were able to attend. Milo Robinson (FGDC), Steve Gillespie (USGS), and David Moyer (Wisconsin State Advisor, National Geodetic Survey) participated, along with LICGF project staff David Hart and Steve Ventura.

Two findings came from this meeting. First, initial analysis of the NFS by Steve Gillespie indicated that the sampling frame was substantially flawed. A wide variety of methods were used to solicit participation in the survey. This resulted in a highly variable response rate between states and between different categories of respondents. Therefore, comparisons between jurisdictions and extrapolations to a national level could not be done reliably or with statistical validity. The patterns may provide a general indication of levels of activity, but are not a good indication of data availability or other potentially derived information. The patterns are significantly biased by factors such as choices in sampling methods, recruitment methods, and sample frames made by state coordinators.

The second major item of discussion at the Chicago meeting was a need for and interest in a follow up to the NFS. Two ideas and sets of activities were discussed. The concept of a "core" set of questions to meet federal information needs, nested within a state survey (or other organizational frame) was discussed. This led to interest in organizing a meeting with potential stakeholders, including representatives of organizations that might be in a position to help survey a segment of the GIS data producing and/or managing communities such as professional organizations (e.g., NSGIC, National Association of County Organizations, Urban and Regional Information Systems Association, and UCGIS), state and federal agencies, and trade organizations. We also talked about inviting companies that might be interested in helping underwrite surveys for the market information they would generate. The meeting was tentatively scheduled for Vermont in early summer, 2000. It never transpired, due to busy schedules and shifting priorities.

Another set of concepts and activities discussed at the Chicago meeting was the use of a completely Web-based approach to a framework survey. The LICGF research team was in the midst of designing and coding a Web-based survey for Wisconsin. Useful feedback and encouragement were provided, and we went away the sense that using project resources to complete and document our Wisconsin experience would be valuable to other states, and possibly would provide the technical basis for a nested approach.

During the Summer and early Fall, we continued to learn in an informal way about what other states were doing or contemplating as a follow up to NFS. Actually, as became clear when our research into this was formalized, most state activity is not a follow-up to the NFS per se. Rather, what has happened is a variety of tools and approaches to meet state-level information needs about GIS activity. It became apparent that it would be useful and perhaps necessary to know what the status of state efforts was before trying to

develop a strategy for another national effort. Therefore, the objectives of our project that emerged are:

- to develop, implement, and evaluate a Web-based statewide survey of local government GIS activity in Wisconsin;
- to determine what every other state is doing to obtain similar information, along with the scope, strengths, and weaknesses of their methods;
- to provide recommendations on potential methods for conducting inventories of spatial data at state and local levels.

II. Tools for Continued Monitoring of GIS Activities

Purpose

Although the impetus for the Wisconsin inventories and the NSGIC/FGDC National Framework Survey (NFS) have been different, substantial overlap exists in their methods and goals. Many other states, such as Arkansas, Georgia, Indiana, Louisiana, Michigan, and Minnesota have similar interests in tracking state and local GIS activities. Future surveys could be developed that nest national questions within state efforts, thus providing a national overview while generating greater detail in jurisdictions interested in such data. Coordination of state-level inventories with national surveys would eliminate duplication and enhance interpretability.

This paper presents the results of an inventory of primarily state-level surveys of geographic information systems (GIS) conducted since the National Framework Survey (NFS). In Section II, a brief summary of the NFS is provided. Section III describes the project methodology, while Section IV reports on recent state-by-state GIS survey activities, along with the scope, strengths, and weaknesses of their methods. Section V offers a general overview of the core questions asked by current GIS surveys. Finally, in Section VI, recommendations will be proposed for future co-evolution of state and national survey efforts, including an evaluation of Internet-based methods that may be applicable, based on our comparison of state and national efforts.

The National Framework Survey

The National States Geographic Information Council (NSGIC) and the Federal Geographic Data Committee (FGDC) conducted the National Framework Survey (NFS) during 1997-98 in an effort to determine the locations and activities of organizations involved with framework data. Used frequently by GIS applications of various disciplines, framework data function as a common foundation for users within a geographic area. The framework data themes addressed in the NFS include: geodetic control, orthoimagery, elevation, transportation, hydrography, governmental units, and cadastral information.

Each state compiled its distribution mailing lists for the NFS. States were required to survey counties, but other organizations such as state, federal, or regional government, municipalities, educational institutions, and private firms were up to the discretion of each state's survey coordinator. NFS respondents completed the survey electronically using a Windows based diskette application or the World Wide Web.

A Framework Data Survey Update Questionnaire, administered August-September 1999, followed the NFS. Forty-six states responded. Of those that responded, 70% had downloaded the survey results, but only 48% had used the results (N=46) and only 32% indicated that the survey had helped with framework development within the respondent's area (N=44). Even so, 91% said that they would like to see the survey results updated and kept current (N=46). Some cited, however, that a more tangible connection to local interests and activities needed to be made.

When asked if a web-based version of the survey would be beneficial, 91% responded affirmatively (N=46). Two-thirds of the respondents (64%, N=44) felt that such an online survey should be made available on a continuous basis. However, the percentage of potential respondents from each state that would have access to the Internet ranged from 32-100% (average 76%; N=44). Alternative methods suggested included: 1) paper surveys (48%); 2) surveys made available at statewide or user group meetings (e.g., via a laptop); 3) diskette as with the first survey; 4) CD; 5) library access to web; and 6) phone interviews conducted by survey coordinator. While most respondents (86%, N=43) indicated that their organization would be willing to facilitate participation of those lacking web access, the majority could dedicate no more than seven days per year (54%) to the effort.

Methodology

This project was conducted from July 2000 through February 2001. Initially, we searched both state GIS data center websites and the NSGIC State Geographic Information and Related Technology (GI/GIT) profiles for an indication of which states might be conducting NFS updates. Second, we e-mailed state contacts, as listed on the NSGIC website, for information about surveys of GIS activities administered within their state. Unfortunately, this contact information often proved to be incorrect or outdated. Third, we tracked down the correct contact information as best we could and then sent out several rounds of e-mails over the next few months to those states that had not responded to the first e-mail and to those contacts whose first e-mails had bounced back. In a last ditch effort, we sent out a final round of e-mails five months later to approximately 20 states who still had not responded. We also sent out follow-up e-mails to those who had promised to send more information about their surveys but who had not had the opportunity to do so. The last round of e-mails did not improve results appreciably, so we made multiple attempts to contact the remaining states by phone. This, in some sense, produced richer information, but turned out to be as labor intensive as e-mailing.

State-by-State Inventory of GIS Survey Activities

All fifty states responded to our inquiries (Table 1). Of those who responded, twenty-one states have conducted formal surveys of GIS activities at the state or local levels since the NFS. Twenty-nine states have not conducted formal surveys, although several intend to do so in the near future. These states cited informal methods for acquiring this information. States obtain information on GIS activities in a variety of ways, ranging from “person-to-person” approaches, traditional paper surveys, and on-site or phone surveys to innovative web-based systems. Often methods are combined to improve the response rate. These methods will be discussed below.

"Person-to-Person"

Smaller states, such as Delaware, Hawaii, Massachusetts, Rhode Island, Virginia, and Vermont, and states with small populations, such as Alaska, indicated that they were able to keep apprised of statewide GIS activities through direct contact with users.

Virginia has made direct person-to-person contact a priority. With a strong mandate from the General Assembly to coordinate at all levels of government, the Virginia Geographic Information Network (VGIN) has assigned one coordinator specifically to state agencies, and another to local government. This arrangement has enabled the state to closely monitor GIS activities.

As the "official" repository of GIS data at the state level, the Massachusetts Executive Office of Environmental Affairs (EOEA) Data Center ("MassGIS") has a good handle on what data are being developed and managed by state agencies because these agencies are encouraged/required by the Administration and Finance to coordinate with the EOEA Data Center (Chritian Jacqz, Massachusetts GIS Manager, EOEA Data Center, September 2000). At the local level, the EOEA meets regularly with regional planning agencies[1] to exchange information about on-going activities.

Michael Mahaffie, Planning Program Manager for the Delaware Office of State Planning Coordination, pointed out that all the GIS users in Delaware could be gathered at once in a good-sized conference room. In fact, between the quarterly Delaware Geographic Data Committee meetings and the quarterly State Mapping Advisory Committee meetings, ample opportunity exists to find out what GIS activities are taking place.

Other states, such as Mississippi, Missouri, and Utah, also have found that user group meetings, workshops, annual GIS conferences, and the regular meetings of state GIS coordinating bodies are an effective means of keeping track of GIS activities. For example, the Mississippi Automated Resource Information System (MARIS) user group, which meets on a monthly basis, actively seeks participation by federal, state, local, and private sector representatives. According to Paul Davis, former Director of MARIS, involving mid-management and technical level staff (i.e., "the folks who get things done") proved a very successful means of sharing resources and identifying data needs.

With only a handful of boroughs, Alaska has collected information about GIS activities in two ways. First, the Alaskan Geographic Data Committee, a state council composed of Federal, State, local, private sector, and Native organizations, meets 3-4 times a year to work on GIS priorities and needs, with an emphasis on framework development. Second, Alaska conducted a "GIS needs workshop" in which breakout session participants identified GIS data needs for specific applications.

The idea of a GIS Needs Assessment workshop is not new to MetroGIS, a geographic information system project in the seven county Twin Cities area. The Hydrography Committee of the Minnesota Governor's Council used the results from the "hydro"

[1] County government does not exist in Massachusetts.

portion of the original NFS survey to contact organizations for more in-depth information regarding water data needs. Then, in October 1999, Metro GIS and the Hydrography Committee jointly sponsored a "Hydrography Data Needs Assessment Workshop." MetroGIS has held a number of these sessions, bringing together "subject matter experts" from a variety of public agencies, to identify priority data in a subject area and to identify basic data specifications in an effort to develop data sets of broad usability.

Table 1. States that have conducted formal surveys of GIS activities at the state and local levels since the National Framework Survey (NFS) 1997-98

State	**Formal Survey since NFS?**		**State**	**Formal Survey since NFS?**	
	Y	**N**		**Y**	**N**
Alabama		X	Montana		X
Alaska		X	Nebraska		X
Arizona	X		Nevada		X
Arkansas	X		New Hampshire	X	
California		X	New Jersey	X	
Connecticut		X	New Mexico	X	
Colorado		X	New York		X
Delaware		X	North Carolina	X	
Florida		X	North Dakota	X*	
Georgia	X		Ohio	X	
Hawaii		X	Oklahoma	X	
Idaho		X	Oregon		X
Illinois		X	Pennsylvania	X	
Indiana	X		Rhode Island		X
Iowa		X	South Carolina	X*	
Kansas		X	South Dakota		X
Kentucky		X	Tennessee		X
Louisiana	X		Texas		X
Maine	X		Utah		X
Maryland	X		Vermont		X
Massachusetts	X		Virginia		X
Michigan	X		Washington		X
Minnesota	X		West Virginia		X
Mississippi		X	Wisconsin	X	
Missouri		X	Wyoming	X	
TOTAL	**21**	**29**			

* South Carolina and North Dakota hired private consultants to conduct user needs assessments.

Arizona has not conducted a formal statewide survey of GIS activities since the NFS. This information, however, has been communicated to some extent through presentations made by the members of their Coordinating Council, which is comprised of representatives from state, federal, regional, and local government, as well as the private sector. Like California, Arizona also acquires information on GIS activities around the state by asking ESRI, Inc.

In addition, Arizona is developing a statewide PLSS implementation plan using the Office of Management and Budget's (OMB) Framework Implementation Team (I-Team) model to support cadastre integration among the western states. Currently, Arizona is conducting a PLSS pilot project within three of its counties, but will extend this effort to all counties this year. The PLSS project involves a detailed township-by-township analysis of PLSS status and activities. Information is collected and exchanged through phone calls, emails, FTPing, and the Internet. However, e-mail and Internet access is limited across the state. Five other framework themes (e.g., parcels, transportation, elevation, imagery) will be selected and addressed using the I-Team approach in the future.

Connecticut does not have an official state GIS coordinating council nor a state GIS office. To further complicate matters, Connecticut has 169 cities and towns and no county government. Thus, as the number of cities and towns that use GIS grows, getting a handle on GIS activity within the state becomes more difficult.

The Connecticut Department of Environmental Protection has become the de facto coordinating entity. They have hosted the Connecticut GIS Expo for a number of years and, more recently, have partnered with ESRI, Inc. to host Connecticut ArcUsers Days. In addition, they are trying to form a coordinating council and to get a GIS user group up and running. As with other states, the GIS user group provides a forum for networking and presentations that convey ongoing GIS activities. Environmental Protection, however, is interested in developing a website, a listserver, and a web-based GIS survey for the state in the near future. Jonathan Scull, GIS Coordinator for the Department of Environmental Protection, comments that a survey of statewide GIS activities would allow the state to identify areas of need and to develop tools, services, and products that better meet the needs of the towns. In the future, he would like to see other stakeholders become involved through the survey process, such at the Connecticut Conference of Municipalities, which might not otherwise participate.

Phone and On-Site Interviews

Four states – Massachusetts, Ohio, Pennsylvania, and Virginia – are conducting surveys by phone or through on-site visits.

Massachusetts

For the last two years the Massachusetts EOEA Data Center has been collecting information about local level GIS activities, particularly with reference to tax mapping of

parcels. Initially, this information was acquired via a mailing that included the NFS and their own survey instruments. Recent updates have been made through phone interviews.

Ohio

The Ohio Geographically Referenced Information Program (OGRIP) has spent the last several years identifying specific points of contact regarding GIS at the county level. To supplement their knowledge of GIS activities, gained by working closely with local government, OGRIP has developed a "county profile" for capturing relevant information about each program. These profiles cover organizational and management structure, funding sources, qualifications required by GIS positions, phase of GIS development, database design, data availability, hardware/software platforms, major applications, and of course, GIS data sets created and used. With 88 counties, most of which are in some phase of GIS development, populating the county profiles has taken longer than anticipated. OGRIP found that on-site visits or phone interviews produced the best results.

The OGRIP county profiles are maintained in an ACT database, a Symantec contact management database that interacts with MS Word and Lotus Notes. OGRIP uses ACT because it allows them to track activities, write memos, letters, notes, and maintain a history of activities. Stuart Davis, Executive Director of OGRIP, indicated that, while the majority of what they need to do with the OGRIP address database is straightforward, the county profile application required some extra effort.

Pennsylvania

PA MAGIC conducts a phone survey each year of county GIS activities. Questions cover cost recovery and data access, data distribution policy, GIS planning, coordination with adjacent counties, metadata development, and source scale of data layers such as roads, parcels, streams, topography and ortho-imagery. The results of this survey are posted on the Internet.

Virginia

In the spring of 1999, the Virginia Geographic Information Network (VGIN) conducted a follow-up to the NFS. This phone survey produced 1/3 more respondents indicating GIS activity than had been reported by the original framework survey. According to Bill Shinar, Coordinator for VGIN, unless a survey is regionally or locally managed, it is difficult to get an accurate assessment of GIS use.

Hardcopy Surveys

Paper surveys have been the traditional survey instrument. Often, however, these must be followed with additional notices, phone calls, or on-site visits to garner a satisfactory response. Some states have chosen to combine a traditional hardcopy survey with a web-enabled survey. These web-based initiatives will be discussed in the following section. Other states, like North Dakota and South Carolina, have opted to hire an outside consultant to conduct a GIS user needs assessment of the participating agencies.

Maine

To support legislation that would establish a coordinated state/regional GIS and to fine tune budgets, Maine recently conducted a general survey of regional planning commissions to determine existing GIS capacity. Surveys were sent via e-mail as an MS Excel spreadsheet to eight RPCs plus the College of the Atlantic and the Island Institute. All returned the surveys and participated in a focus group that reviewed the surveys and filled in the blanks.

North Carolina

In a September 2000 Memorandum of Agreement with the Federal Emergency Management Agency (FEMA), the State of North Carolina agreed to become the first cooperating technical state (CTS) for flood hazard information and to assume the responsibilities necessary for maintaining up-to-date, accurate Flood Insurance Rate Maps (FIRMS) and the Digital Flood Insurance Rate Maps (DFIRMS). As a CTS, North Carolina is conducting a "wall-to-wall, comprehensive study" within the state, "working with all communities to insure satisfactory mapping." The "GIS Data Availability Survey," administered as part of the Floodplain Mapping Program (FMP), is designed to inventory local digital GIS data resources and assess related data policy. Framework data layers such as orthophotography, elevation, transportation, hydrography, governmental units, and cadastral information are addressed.

North Carolina's Center for Geographic Information and Analysis (CGIA) is conducting the survey from November 2000 – June 2001. The detailed, 18-page GIS survey is being distributed both in paper format and as a MS WORD email attachment to counties and municipalities. A CGIA representative will meet with each respondent *in person* to review the completed survey and to answer questions. In this way, CGIA hopes to expand its relationship with local government. Full participation is expected.

North Dakota

Until recently, state agencies in North Dakota operated their GIS independently of each other. In 1999, the GIS Technical Advisory Committee asked the State's Information Technology Department (ITD) to conduct a study of GIS activities as part of their strategic planning process. Hence, the Convergent Group, a private consulting firm, was hired to conduct a GIS user needs assessment of state and local agencies. The recommendations from this study were then used successfully to petition the Legislature to fund a centralized data repository.

New Hampshire

In an effort to develop a statewide GIS strategic plan, the New Hampshire GIS Advisory Committee is conducting a voluntary "Survey of GIS Use in New Hampshire." This 4-page survey inquires about access to GIS, GIS software used, training needs, and the status, source, and scale of different data layers (e.g., roads, structures, utilities, public facilities, parcels, zoning, elevation, wetlands, soils, groundwater, environmental hazards, land use, and demographics). The survey was mailed to State and Federal agencies, in

addition to all 234 municipalities. As of December 2000, one hundred and fifty responded to the three hundred surveys mailed out. A second notice was mailed, extending the deadline. Results have been compiled and are posted at the NH GRANIT web site: http://www.granit.sr.unh.edu.

Oklahoma

The Association of Central Oklahoma Governments (ACOG) completed a survey of GIS activities in August 2000. The survey addressed what GIS software was being used, data sharing and metadata activities, aerial photography development, roads and other data themes maintained. Counties, municipalities, and state agencies within the Oklahoma City metro area were targeted, along with appropriate federal agencies. The survey, distributed in paper form and via e-mail, was followed with reminder notices and phone calls. While roughly seventy (70%) percent of the cities responded, only forty percent (40%) of state agencies replied to the survey. John Sharp, Program Coordinator CDP&S for ACOG, noted that this survey method was very labor intensive. This was further exacerbated by the fact that contact names from the NFS were already out of date. Furthermore, many agencies have multiple departments using GIS with little or no coordination between them. It was sometimes unclear who should be contacted.

South Carolina

Charged by the Governor's Information Resources Council (IRC) to coordinate the development and management of geographic data in South Carolina, the Standing Committee on Geographic Information (SCGI) hired PlanGraphics, Inc. to conduct a statewide GIS needs assessment and to develop a strategic plan to facilitate GIS coordination. PlanGraphics, Inc., as part of the strategic planning process, has gathered information about GIS activities in a variety of ways. First, PlanGraphics facilitated on-site group workshops and individual interviews that focused on particular topics and allowed for a cross-section of departments to participate. Second, PlanGraphics completed two phases of surveys. Distributed in hardcopy format and as an MS Word document via e-mail, the first survey was sent to all state agencies, whether known to be active in GIS or not, and addressed a broader range of issues than the original framework survey. PlanGraphics then followed-up with phone calls, e-mails, and on-site visits. Nearly 100% of those state agencies known to be active in GIS responded. The second survey targeted specific agencies at the state and local levels and sought information on expenditures and benefits of GIS.

Web-based Surveys

Web-based surveys can circumvent the high costs of telephone or mailed surveys and may require fewer people to administer. Survey software, which translates the survey questionnaire into HTML, can help with web survey development. PC Magazine provides a guide to what available in its February 8, 2000 and January 16, 2001 issues.

Wyoming supplemented the original NFS with its own web-based survey. Of those states that have conducted formal surveys since the NFS, nine states – Arkansas, Georgia,

Indiana, Louisiana, Michigan, Minnesota, New Jersey, New Mexico, and Wisconsin – have implemented web-based surveys, some in combination with hardcopy surveys or in conjunction with a Clearinghouse website. Texas also hopes to conduct a web-based survey next year, focusing on state agencies initially but expanding to local government with time. In addition, Kansas has developed preliminary plans to implement a web-based application, called the Kansas GIS Landscape, that would essentially web enable the framework survey and provide each cooperating organization with a "web page" on Kansas' NSDI Clearinghouse web site. However, because the FGDC has provided limited funding, Kansas has not been able to move forward with these plans.

On the other hand, some states, such as Maryland (http://www.towson.edu/cgis/metadata) and Florida, are trying to encourage participation in a Clearinghouse, rather than pushing to create ongoing inventories. Bill Burgess, Geographic Information Services Division, Maryland Department of Natural Resources, noted wryly that this "means that they have to do metadata and that is still the "wrinkle" in this effort."

Arkansas

The Arkansas State Land Information Board (SLIB), as required by Act 914 of 1997, must keep apprised of the land information needs of federal, state, county, regional, municipal, and private users within the state. To this end, the SLIB conducted a second generation Framework Data Survey, modeled directly after the NFS, in the beginning of 2000. The same format and questions of the original framework survey were utilized, with minor exceptions. The survey was divided into various themes. Each referred to a different framework data category. A sub-theme under the elevation for floodplain data also was included, the results of which will be used to support additional coordination between Arkansas and FEMA. In addition, the final question requested feedback about future direction for the SLIB.

The Arkansas State Land Information Coordinator's office first compiled the contact databases, comprised of nine different categories (i.e., utility companies, cities, counties, state, federal, E911, universities, civil engineering, and forestry), into a single database. Then the Coordinator's office announced the survey by mail, indicating that participants could respond via the Internet if they so desired. Within three weeks, sixty had responded online. Those who had not responded on the web were sent a paper copy of the survey. In all, over 2000 announcements/surveys were mailed. Of the 560 respondents, 193 completed the survey online.

The Arkansas Online Survey was designed using Visual Café, a Java development tool. The participants and their responses are stored in a Microsoft SQL Server 7.0 relational database running on a Pentium based server with the Windows NT 4.0 operating system. Interface between the web pages and the database is handled using Java scripts. This implementation provided the greatest amount of browser independence. Users were only required to have at their computer the current Java Plug-in. For analysis and summary of survey results, the database connection through ODBC using Microsoft Access was used.

Each user was assigned a unique serial number, which was required to access the survey. Ensuring that the correct survey and access code went with the correct envelope when the hardcopy surveys were mailed consumed a lot of time. Once a survey was completed, the record associated with that serial number would be locked and could not be used again. If a user entered "no" to the very first question ("Do you create, update, integrate, and/or distribute digital geographic data"), the user would be jumped to the final question. All other skip questions took the user to the next framework category.

The web-based survey greatly reduced the need to mail the survey instrument. In addition, the Arkansas State Land Information Coordinator regularly uses the database generated when traveling to various parts of the state or when referring interested parties to particular areas of expertise.

Georgia

The Department of Community Affairs (DCA), which chairs the State Mapping Advisory Board (SMAB) and which is mandated by the Georgia Legislature to perform specific GI/GIT duties, required the Regional Development Centers (RDC) to conduct an inventory of the cadastral data maintained by county governments. From August-October 2000, the RDCs contacted the counties within their region and then submitted the results electronically to the DCA through a web-enabled survey form. All 159 counties were surveyed.

The Georgia survey was designed using MS Visual Studio. The participants and their responses are stored in a Microsoft SQL Server 7.0 relational database. This is run on a Pentium based server with a Windows NT 4.0 operating system running IIS (Internet Information Server). The survey is maintained with other ASP/HTML editors.

Indiana

The Indiana GIS Initiative and the Indiana Geographic Information Council's objective is to increase GIS coordination through 1) dissemination of data and data products; 2) adoption of standards; 3) partnership building; and 4) education and outreach. As part of the GIS strategic planning process, Indiana is pursuing a statewide survey based, in large part, on the FGDC/NSGIC National Framework Survey. This new survey will go out to approximately 300 individuals, representing federal, state, and local government, the private sector, and utilities. Some of these individuals will be contacted personally to encourage a response. A sub-survey will target academic institutions in Indiana. In addition to the guidance this survey will offer the strategic planning process, one anticipated benefit is improved networking through the creation of a "GIS Rolodex."

This survey, announced in the Indiana GIS Initiative Newsletter in January 2001, is accessible via the Internet (http://www.polis.iupui.edu/ingisi/survey) and takes approximately 10-15 minutes to complete. The backend database is MS Access 2000 and the web site is hosted on a Windows NT 4.0 Server running MS IIS 4.0 (Internet Information Server). Data access is provided through ADO with ASP using VBScripts in the server. Data validation entry is accomplished at the client browser using JavaScript.

No special client software/plug-ins is required. The site was tested on both Navigator and Internet Explorer.

Louisiana

The LAGIC/Louisiana GIS Council Resource Inventory is a web-based inventory of the geospatial services, expertise, data and metadata maintained by the seventeen member agencies of the LA GIS Council (LGISC). Initiated in 1996 and operational to date, the Inventory allows Council members to access and update resource information for their organization via the World Wide Web. The inventory was originally intended to supply information for the creation of a thesaurus for a planned, on-line metadata development application. However, following a one-year pilot project, LAGIC and LGISC concluded that a scaled down services catalog would better serve the community.

The 2000 inventory provided for the following:

a) Staff (including contact information)
    - Distributed Administration Permissions
    - Addition or Deletion of Contacts
b) Computer Systems Information
    - Platform
    - Operating System (Version)
    - Related Hardware
c) Data Sets
    - Available to the Public
    - Not-Available to the Public
    - FGDC compliant metadata
d) Projects/Efforts
    - Project Name, Status and Availability
    - Keywords
e) Services
    - Outreach Efforts
    - Distributed Products

Of the seventeen member agencies in the LA GIS Council (LGISC), roughly twelve are considered active participants. Eleven of these twelve agencies responded to the survey in the first two years. In 1999, this number dropped slightly to ten responses. But, by 2000, only eight agencies completed the survey. This decrease in the response rate did not occur for lack of prodding. Those that did respond to the survey had to be called directly and walked through the survey over the phone.

According to Joshua Kent, LAGIC Data Manager, there were many factors that accounted for the drop in participation for the 2000 inventory. Despite the fact that many Council members had been actively involved in the survey's development, it had been difficult inspiring people to complete the survey since the novelty of the web had worn off. Surprisingly, users did not seem aware that they could update their information at any time. In addition, some agencies were reluctant to complete certain portions of the survey, particularly the detailed questions about hardware, for security reasons. To

accommodate these concerns, the survey results cite percentages – rather than actual figures – on the sensitive portions of the survey. Finally, during the inventory period, the LAGIC director resigned, leaving the position vacant for 6 months. The LAGIC director had considerable influence in the Council's agenda and her departure may have contributed to the lack of participation.

The LA GIS Council has discussed options for increasing participation in the Online Inventory. A production schedule for a new resource inventory will be ready this summer. These efforts correspond to the creation and filling of a new state executive position/office, the Chief Information Officer (CIO)/Office of Information Technology (OIT). The updated GIS Resource Inventory will encourage Council participation while it provides basic and succinct details about the services provided by these agencies for the OIT.

The LA GIS Council was created by the state Legislature in 1995 "to eliminate duplication of effort and unnecessary redundancy in data collections and systems and to provide for integration of geographically-related data bases to facilitate the policy and planning purposes of the state of Louisiana (La R.S. 49:1051-1057 (Acts 1995, No. 922))."

LAGIC was established in 1996 by the Louisiana GIS Council and the Louisiana Data Base Commission (LDBC) to facilitate the distribution of geographic information, provide technical assistance, and support GIS data development among state, federal, and local government.

Enacted by Executive order of Governor M. J. Foster, the CIO is responsible for establishing IT standards and guidelines suitable for statewide implementation, for assessing the performance of IT systems and technology operations, and for overseeing and/or coordinating the centralization of the technology systems and data processing systems, including consolidation and outsourcing. The OIT will assume the role of the LA Data Base Commission (ODBC), which helped to enable the LA GIS Council (LGISC) and the LA Geographic Information Center (LAGIC).

The LAGIC/LA GIS Council Resource Inventory requires roughly three months of a full time staff member each year for upkeep. The inventory web site was developed using MS Visual Studio (Visual Interdev), FrontPage 98/2000, and Macromedia Dreamweaver 3.0. The MS Access 97/2000 database runs on a Pentium based server with the Windows NT 4.0 operating system. The interface between the web pages and the database is handled using Active Server Pages (ASP). The primary scripting language was VBScript, HTML, and XML. This solution requires that the LGISC Member or appointed editor have Internet access and a web browser 4.0 or greater. In the future, the web inventory front-end will be updated to encourage participation. Suggestions include using Macromedia Flash to attract participants.

An unanticipated problem encountered with the inventory was how to account for multiple entries for a given agency. Previous inventories assigned passwords to each of

the Council members in order to access and complete the survey. However, it was often the case that the Council member would distribute the password to different project heads within their agency. As a result, one editor would fill out the survey and another would alter or delete that response. Thus, the final survey response would not accurately represent the entire agency. The 2000 Inventory corrected this by providing distributed access. This allowed a Council member to assign *edit* privileges for certain users within their organization. Editors were could not alter information submitted by others, only the information he/she entered. Only Council members were granted full-control over their agency's information.

Michigan

The Michigan Information Center, in cooperation with the non-profit GIS organization IMAGIN, is conducting a comprehensive GIS inventory called the Michigan Geographic Resources Inventory (MGRI). The overall goal of this Inventory is to facilitate communication and the exchange of geographically oriented ideas and data. To this end, the Inventory provides an overview of the organizations that use GIS, thus furnishing useful information that might not otherwise be uncovered by a straight metadata search. In addition, the Inventory affords an easy method to create and communicate a quick summary of projects currently planned or in progress, which are often of interest to others but again not captured by metadata. By making information about these projects available, the Michigan Information Center hopes to spur collaboration and data sharing. Finally, in some instances, metadata does not exist or is slow to be produced after data creation, especially within the context of smaller organizations. Thus, the Inventory offers another avenue to communicate what these organizations are doing or planning in regards to geographic information.

The Michigan Geographic Resources Inventory is available both on the web and in paper form. Because typical "surveys" lose much of their value as they become outdated, this inventory was designed as a dynamic system, continually updated by users. The Inventory is open to a multitude of organizations, including federal, state, regional, counties, sub-counties, watersheds, towns, villages, school districts, educational institutions, Native American communities, private companies, private consultants, and non-profits. Each of these organizations must have a user name and password or a five-character access code to read and submit the survey.

IMAGIN publicized the inventory through advertisements in a local government-planning magazine and through promotional activities at GIS conferences. Respondents are allowed to supply whatever level of participation they are willing to contribute. Thus, some of the 180 who responded by the end of 2000 supplied only basic information. However, compiling a good statewide database for GIS organizations is considered an important step in the right direction.

Dan Metzger, Geographic Specialist for the Michigan Information Center, indicated that they hope to reach a "state of critical mass," the point when the majority of organizations highly active in GIS development have some presence in the Inventory. At this point, Metzger foresees that more people will see the Inventory as an important source of

information. These people, in turn, will not want to be left out and so begin to participate. With some necessary cheerleading, Metzger believes they can reach their goal.

Nested within the Michigan Geographic Information Clearinghouse, the Michigan Geographic Resource Inventory Online Survey was designed using MS Active Server Pages (ASP) 2.0 with VBScript as the base language. Data is stored in a MS Access 97 relational database running on a dual Pentium based server with the Windows NT 4.0 SP6 Server operating system. This implementation provides the greatest amount of browser independence because the client receives only HTML. User requirements are a computer with a browser that supports frames (Netscape and Internet Explorer 3.0 and up). For analysis and summary of survey results, Crystal Reports will be used.

Minnesota

The Minnesota Governor's Council On Geographic Information and the Minnesota GIS/LIS Consortium initiated the GIS Data Needs Survey in October 2000. Announced at the annual state conference, by mail to the 2500 consortium members, and in the GIS Newsletter, this survey encompasses priorities that reach beyond the framework. The current survey is primarily web-based, although hardcopies are available to those who request them. The survey asks respondents to indicate five GIS data priorities, the scale at which they would be most useful, and the reason why the current data may be inadequate. Multiple options are provided from which to select the type of data, scale, and reason. The survey is short, taking only 5 to 10 minutes to complete.

The survey closed "officially" on Jan 1, 2001. However, the site will be left open for further updates. Over the course of three months, roughly 250 users responded online, primarily from state agencies, federal agencies, and counties. Cities and towns have not been that active.

MS FrontPage was used to design the survey and to provide some of the field validation (i.e., to check that required fields were completed). The survey was made available on Minnesota's web site, running a Linux (RedHat 7.0) operating system, and was administered at the annual conference using a computer with a dial in net-connection. A password is not required for access to the survey, but the IP address is checked so as to prevent repeat submissions. Once submitted, the survey results were sent both to an e-mail box and to a comma delimited text file on the server, which then could be downloaded later for analysis using MS Excel or another spreadsheet.

New Jersey

For the last five years, New Jersey has surveyed the GIS user community and published the results in the New Jersey GIS Resource Guide, originally intended as a GIS primer and now available on the Internet. The surveys, which indicate the progress of framework data development, have been a strategic asset for New Jersey. The results have been presented to the state legislature, resulting in an award of two million dollars for framework data development for FY02.

The most recent incarnation of the survey is intended to be dynamic. Thus, the new survey instrument is embedded within the Clearinghouse website (http://njgeodata.state.nj.us). Users must first "register" before they are permitted to utilize the Clearinghouse, a process that first asks whether the user is an individual or represents an organization. The user also is asked if they are the *primary contact* for that organization. If the user is the primary contact, the database is scanned to see if that organization filled out the original NFS survey. If yes, the original NFS results are displayed and the user is able to update their responses. If, however, the organization did not participate in the NFS survey, the website walks the user through the core questions of the NFS.

The NJ Office of Geographic Information Systems announced the survey and conducted demos at a meeting of the New Jersey State Mapping Advisory Committee (SMAC), which is comprised of 500 members. In addition, GIS users listed within the Resource Guide were contacted and members of a coordinating council were reminded to register. The current survey has not been aggressively marketed, however, because the web survey is still being refined. Within the four months the survey has been up, 150 users have registered and completed the survey, including representatives from state agencies, counties, municipalities, the private sector, and non-profits.

The survey front end required approximately six weeks to develop, while the overall Clearinghouse required nine months to design and construct with a consultant's assistance. The biggest problem encountered was how to limit the survey such that only one person filled it out per organization. The survey was designed with HTML The participants and their responses are stored in a Microsoft SQL Server 7.0 relational database running on a Pentium based server with the Windows NT 4.0 operating system. The interface between the web pages and the database is handled using PERL.

New Mexico

In August 1999, New Mexico conducted a follow-up to the NFS, using the same basic formula but expanding the scope of inquiry. Distributed either as an e-mail attachment in MS Word or MS Access or as a diskette, this survey targeted state agencies, smaller communities not reached by the NFS, and tribes. The contact list was acquired through the statewide Enhanced 911 Project, which funded counties to use GIS and GPS to build road centerline data layers, the New Mexico Geographic Information Council (NMGIC), the New Mexico Geographic Information Systems Advisory Committee (GISAC), and the New Mexico Resource Geographic Information System (RGIS) Program. Follow-up phone calls prompted a 40-50% return.

At the present time, GISAC, a standing subcommittee of the Information Technology Commission, is continuing this survey using the Internet (http://rgis.unm.edu and look under GISAC), and targeting developers and users of geospatial data at state, regional, and local levels. This survey is intended to feed into the strategic planning and Clearinghouse initiatives.

Although planned as an ongoing effort, the survey is currently an "unfunded mandate." Thus, it is supported through volunteer staff time and to a small degree out of the Clearinghouse budget. For this reason, the survey has not been aggressively marketed. Announcements at GISAC and NMGIC meetings and in NMGIC's newsletter have garnered responses primarily from state agencies.

The delivery of geospatial data to clients through an easy-to-navigate, web-based interface is the core application of the Resource Geographic Information System (RGIS) Clearinghouse Website. The site was developed using several web-enabling technologies that integrate multiple data sources in the generation of dynamic web pages in combination with static pages. The technologies employed include javascript-based hierarchical menu systems that provide for multi-level navigation of the available data sets. These menus access data availability page templates containing ColdFusion (by Allaire Corp.) data query and presentation tags that request data from a Microsoft SQL-Server database that contains descriptive information about all available data sets. The returned data include links to the file metadata, the areal extent of the dataset, a viewable image of the dataset, and access to as many as four different download formats. The site also uses ARC IMS to generate a reference map for assisting users in the identification of quad locations and county boundaries to aid in the definition of areas of interest for interpretation of returned data results. All applications are running under Windows 2000 Server and Microsoft IIS.

Wisconsin

The overall goal of the Wisconsin Land Information Program (WLIP) is to achieve land records modernization in Wisconsin's local governments. The WLIP conducts a survey every year to provide a periodic assessment of the status, progress, and benefits of the WLIP to each of Wisconsin's 72 counties.

The purpose of Wisconsin's WLIP web page is to provide an overview of the WLIP, to present the results of past assessment surveys, to permit future electronic assessment surveys, and to solicit comments and/or suggestions regarding any aspect of past or current WLIP assessment surveys. The hope is that this web site will provide a forum for enhancing the WLIP and for facilitating (through observation, analysis, and discussion of the data) the best possible use of collected assessment survey data.

The 1999 Wisconsin web-enabled survey (http://www.lic.wisc.edu/wlip) was hosted at the University of Wisconsin-Madison on a Windows NT 4.0 Server running IIS (Internet Information Server) and was created using a variety of tools. It was developed with MS FrontPage, but is maintained with other ASP/HTML editors. The heart of the website is an interaction between the user and a MS Access database using Active Server Pages (ASP). In addition, ActiveX Data Objects (ADO), VBScript, JavaScript, and HTML extend the capabilities of the website." The 2000 annual survey (http://www.doa.state.wi.us/olis/wlip/survey2000/Index.asp) was hosted by the Wisconsin Department of Administration using Microsoft SQL Server.

The Wisconsin survey is discussed in further detail in Appendix C.

Wyoming

As mentioned above, Wyoming conducted a web-based survey, also provided in hardcopy format, as a supplement to the original Framework Survey (http://wgiac.state.wy.us/directory/). Hardcopy responses had to be key punched into the database. The Wyoming GIS Data Survey provided the information that now populates the Wyoming GIS Directory. It requested contact information and information about a large variety of data layers, including scale, format, accessibility, metadata, areal extent, source of data, and availability online. Over seventy-five percent of the recipients responded, but many follow-up phone calls and e-mails were required. Wyoming is interested in updated the survey in the near future.

III. Survey Question Comparison

Appendix A provides a direct comparison of many of the GIS surveys being conducted. Not surprisingly, the most commonly requested information amongst the surveys is contact information. The serial number or county identification number provides an access code for web-based surveys and allows the hardcopy surveys to be linked both to a database and to a mailing list. Contact name, Title/Position, Organization/Agency, Address, County, telephone, fax, and e-mail addresses are fundamentally important. Many surveys also thought to include the website address and some wisely requested the name and address of an alternate contact. Interestingly, one survey asked if the contact information should be kept confidential. In addition to the contact section, half of the surveys ask if the survey respondent's organization creates, updates, and/or distributes geographic data and end the survey if the answer is "No."

As with the original NFS, nearly half the surveys ask for the organization's jurisdiction or service area and for the names of government entities within their jurisdiction. Other common organizational/institutional structure questions touch on the phase of GIS development, how long the organization has been involved with GIS, and how many employees participate. A few surveys inquire which departments within the organization use GIS. A couple of others ask whether a needs assessment has been conducted, whether a GIS strategic plan has been developed, and whether GIS is administered centrally or is distributed across several departments.

Software questions topped the list in frequency after contact information. Most surveys queried what GIS ad CAD software is used along with the database management systems, operating systems, hardware and peripherals. Only two surveys thought to prompt for links with CAMA. A few others also sought information about GPS use and grade of receivers.

Several surveys asked basic questions of data sharing and partnering. Whether an organization shares data with other organizations is followed with whether an organization distributes data and the format in which it is distributed. These surveys asked if an organization had a formal access/distribution policy, if an organization permitted the redistribution of data, and if an organization charged for data. Public access questions appeared only a few times amongst the surveys. Some of these surveys also wanted to know if the organization participated in a GIS coordinating council, committee, task force, or user group.

Only a few surveys focused on skill sets and personnel needs or touched on training. Those that did asked if an organization provides formal in-house training to its employees, and if so, is this training open to outside agencies. Two surveys also asked for more in depth information about what kind of training is needed. One expanded the questioning to include other forms of communication such as hosting conferences or publishing newsletters.

Metadata is another topic that is not covered often as a separate section in the surveys. Most surveys included it, rather, as part of a line of questioning about particular data sets.

One survey, however, did request the percent of data sets with associated metadata, the percent of metadata that is FGDC standard compliant, the method of metadata capture, and the format used.

Nearly half the surveys requested descriptions of priority GIS applications. While a handful of surveys solicited general descriptions of priority data sets, most surveys inquired about a variety of GIS data themes spanning natural resources, land management, cadastral, transportation, site locations, public administration, and geographic referencing. These surveys often provided a series of check boxes or multiple choices to indicate: 1) whether an organization creates, uses, distributes, or updates these layers; 2) the geographic extent of these layers; 3) the scale of these layers; 4) the frequency of updates; and 5) the data source. A few surveys requested the unit of measurement, the projection/coordinate system, and the horizontal and vertical datums used. Some of the surveys delved more deeply into the framework data layers, although in general, these were patterned after the original NFS (see italicized questions in Appendix A). Finally, some surveys sought in depth information beyond the scope of the original NFS. Georgia, for example, specifically targeted private cadastral data, while North Carolina and Arkansas emphasized flood plain mapping. Most surveys asked for additional comments at the end. Wisconsin specifically asked how much time was required to complete the survey.

IV. Findings and Recommendations

This section contains a series of suggestions oriented toward future gathering of information similar to that generated by the NFS. The biggest challenge to creating data meaningful at a national level is generating reliable and statistically meaningful levels of participation at local levels. Interaction with state coordinators of the previous survey (or their successors in positions involving statewide GIS) as part of this research has provided some explanations of why participation in the NFS was sporadic and the results of limited utility. Building on the Wisconsin experience, we provide recommendations oriented toward future efforts that reduce data gathering efforts while enhancing the value of information generated.

These recommendations are primarily geared toward participation of county governments in surveys organized at state levels (with necessary flexibility for states where counties are not the primary nexus of local land records). This would provide synoptic coverage of the United States, and would sample a level where rapid GIS development and use is currently underway. For other purposes, of course, other sampling frames and units of analysis also are needed. The general approach outlined here should be viable for them as well, if the units of analysis and the organizing frame can be defined with equivalent precision, and if the appropriate organizations for conducting a survey can be identified.

The model is based on the assumption that the FGDC and others will find value in a survey of national scope. Due to the variability in state and local governmental structures, the activity is probably best coordinated at the state level, in spite of the difficulties noted in the NFS. Improvements in the survey instrument and the sampling approach will help. However, based on comments from state coordinators, the biggest barriers are time, money and staff. This is particularly acute in large and populous states (for example, a respondent from the state of Texas noted that they have 254 counties, more than 1200 incorporated cities, and 28 regional governments).

Lacking sufficient funds to entirely pay for a survey, FGDC will still need to enlist the support of state agency personnel. As discussed below, the incentives for this will need to be carefully considered. A payment of $1,000 per state, as provided by the NFS effort, will not be sufficient to elicit state-level participation, particularly from previous coordinators who feel strongly that they were under-compensated for their efforts.

We believe a reasonable long-term goal is to create a continuously updated process for tracking the status of framework data and geographic information system implementation. This would provide reliable, comprehensive status information and feed into NSDI "clearinghouse" efforts. Where direct links into clearinghouses are not feasible, such a system would at least provide contact information.

Issue: *Barriers to participation*

A number of issues create barriers to participation of local and regional governments. From the state coordinators' perspective, having useful and reliable local contact information exacerbates limitations of time and funding. Lack of motivation to

participate and distrust of state and federal initiatives is a common problem at local levels.

Conducting traditional paper or phone surveys requires a considerable amount of time and effort. Bill Burgess, Geographic Information Services Division, Maryland Department of Natural Resources, lamented

> "…getting people to take time out of their schedule to provide information on the activities is WORSE than pulling teeth. In order to get people to do the FGDC Framework Survey, I had to send two letters and often make up to three additional phone calls."

Texas GIS Coordinator Mike Ouimet indicated that to complete the original NFS, as it was intended, would have required "400-500 hours of staff time." For those conducting the survey, time is required to solicit participation in the survey and handle responses. For participants, time is required to complete the survey. These two issues are intertwined – if the survey instrument is long and tedious to fill out, it is more difficult to solicit full participation and it is harder to extract useful information from responses because more forms are incomplete. It was noted by several coordinators that many organizations chose not to respond to the NFS solicitation. This should not be construed to mean that they did not have GIS activity, as presented in some interpretations of the NFS data. Virginia, Texas, and many other states indicated that more people were building framework data than NFS reported.

Several improvements may reduce the time involved in organizing and completing the survey. Use of information must be considered, since it can motivate participation. Information needs of participants must be considered, as well as that of the sponsors. As indicated by the 1999 Framework Data Survey Update Questionnaire, less than one half the state coordinators used data from the NFS; it can only be assumed that use of survey data was far less at the local level. To paraphrase one state coordinator -- *The information was not really of use… The survey had been put together without a lot of input; it looked like it had been put together by a select few.* Others echoed the sentiment that the survey primarily served national needs.

One approach to better serving state and local interests may be the creation of a survey instrument with nested categories of data. A minimal set of information needed for national tracking could be used in all states. A national set of questions should be fewer and simpler than the previous NFS to minimize reporting and data management burdens. Then, states could add additional questions of state or local interest. Appendix A was assembled to provide a starting basis for identifying common interests between state and national level surveys, and possibly for identifying a set of "core" questions that would be common to surveys conducted in all states and subsequently provided to a federal data integrator.

The use of Web-based forms may also help alleviate the reporting burden. In Wisconsin, the average time to complete a standard survey (either mailed or down-loaded) was 6.1 hours for the 1998 survey, with a maximum time of 25 hours. The first effort at a Web-

based survey for 1999 (completed through check-boxes and fill-in-the-blanks within in a standard web-browser) reduced the average completion time to 5.7 hours. For the 2000 annual survey, the average completion time decreased significantly to 3.7 hours. We also have asked direct questions on how people reacted to the survey process, and satisfaction continues to improve substantially. A total of 64 of 72 county contacts (89%) felt the survey was reasonable in length and covered county GIS activities in adequate detail. Although considerable programming may be required to initiate an on-line survey, it has a very significant advantage in data encoding. Responses can be fed directly into a data base management system. In the Wisconsin case and a few other cases previously noted, this data base was linked back to the survey instrument, so counties only need to update fields on the Web form that had changed in subsequent surveys.

Although updates to the Wisconsin survey are now requested annually, it could be set up to manage transactional updates – changes in the status of framework data reported as they occur. If updating the inventories were a routing part of data automation and management, compliance would likely be more extensive. Data quality and completeness could be substantially improved.

To some extent, Web-based approaches may help with the issue of finding knowledgeable contacts in a large agency. If a single point of contact is willing to make the availability of the Web-form known throughout the agency, individuals with appropriate expertise can fill in different portions of the form. In the Wisconsin case, each county Land Information Officer (LIO) was given a password to access the survey database. That individual then shared the password with other employees he or she thought should fill in particular sections of the form. The LIO was ultimately responsible for ensuring that all sections of the survey were completed. Similar limited access approaches were used in Louisiana and New Jersey to ensure data integrity and security.

In our nationwide research, some state coordinators expressed concern that rural and remote counties may not have adequate Internet access or network infrastructure. A few states suggested this would be the case in a large portion of local offices. So, Web-based approaches may not be a universal means to more efficient surveys, particularly approaches requiring rapid connections or recent-release browsers. However, lack of an Internet connection does not need to be a barrier. It is possible to put Web-based approaches on diskettes or CDs and run these locally with an HTML browser. If the HTML and other coding is compact enough to fit on a diskette, responses could be recorded directly and returned on the diskette.

It is unclear the extent to which Web-based approaches will reduce the need for "hand-holding" – walking respondents through surveys step-by-step. A number of coordinators indicated that substantial amounts of time were spent one-on-one with respondents, explaining questions and helping them complete the NFS. Very little of this was needed in the Web-based survey in Wisconsin; however, most respondents had prior experience with a paper-based survey that had similar questions. One potential advantage of the Web, used to a limited extent in the Wisconsin survey, is the ability to provide hyperlinks to explanatory pages. Definitions, scope, and other details need not clutter the survey

form itself but can be readily available. Additionally, "pick-lists," "radio-buttons" and other limited menu choices can be used to guide users to appropriate responses to questions, rather than forcing them to fill in blanks.

Issue: *Creating a structure to conduct a framework survey*

A national survey of GIS framework data (and/or local and state GIS system implementation) requires substantial cooperation from state and local participants. State agencies are in the best position to coordinate and solicit local participation in many but not necessarily all states. In some states, professional associations such as GIS users groups can play a substantial role. Regional or metropolitan agencies may need to be involved in some areas. For example, a respondent from Missouri said, in effect, that 'the St. Louis seven county area doesn't participate in statewide efforts.' Organizational structures that account for this variability need to be developed ahead of time, not as the survey proceeds.

Clearly, an organization such as NSGIC can play a key role in organizing the survey structure. However, their Web directory of state contacts was woefully out-of-date at the outset of this research in Summer 2000. One obtained directly from a NSGIC contact was only slightly better. We have provided a list of contacts that were useful for our research in Appendix B, which may be helpful for updating NSGIC's database of state contacts (these are the people that helped us determine current status; they are not necessarily the official NSGIC representatives).

The issue of how to structure participation of local governments is much more difficult. In many states, soliciting counties will capture a useful first cut at framework data development. However, in some states, county government is quite nominal and would not be expected to be significantly involved in spatial data base development. In some areas, city, metropolitan, and regional governments have substantially superceded county functions or may have up-to-date inventories of data that can be fed into state and national efforts. Moreover, the appropriate office to fill out surveys varies widely and contacts are constantly changing. Even in Wisconsin, where every county has a "Land Information Office," the data base of these contacts is never completely current, and the designated contact is not always the most knowledgeable contact on data-related issues. In other states, another constitutional office such as tax assessor or property lister may provide a consistent point of contact, though again the issue of reaching the most GIS-involved staff remains. In still other states, GIS activity may arise in many different local agencies, making structuring the local contact list a difficult task at best.

In spite of variability in local government structure, it is important for the creators of a survey to have a well-developed sampling frame created ahead of time. A common complaint on the NFS was the changing of instructions given to coordinators over time. A related complaint was failure to inform coordinators how much work and time the survey would require. One coordinator emphatically said "NSGIC/FGDC made lots of last minute requests that went way beyond the scope of what they asked states to do initially."

Clearly, a degree of flexibility is needed – a single requirement for states to survey counties will not be sufficient. The survey itself will need a clear mechanism for delineating what jurisdiction the survey covers. Investigators at state and national levels will need to ensure that responses are solicited from all levels. States will need to be creative, using professional associations and users groups, constitutional offices or other mandates that create statewide local contacts, and informal networks. Incentives such as more useful information from the survey will help as well. Perhaps one of the most useful products to come out of surveys is an up-to-date contact list. This is one component where an effort toward transactional updates would have immense benefit.

Several large and/or populous states raised a question about the need for an inventory. They asked whether some sampling schema could provide aggregate information of similar quality. This should be carefully considered. It would be cheaper to implement and easier to manage. It could provide information about the rates and general patterns of GIS implementation and data generation. However, a sampling approach would provide an incomplete picture of how complete any particular layer was at the local level. In the Wisconsin case, and presumably other states as well, we are interested in building a statewide system that will access and integrate local data; we want to know where there are gaps in data, not have gaps in our information about data due to an incomplete inventory.

This spatial completeness of an inventory needs to be balanced against temporal completeness. If a complete inventory is only feasible or affordable every five years, for example, such a "snapshot in time" may not worth the effort unless it was specifically tied to data integration efforts (e.g., determining the feasibility of assembling state-wide data from local sources). Particularly in large and populous states, reliable, statistically-based samples conducted on a regular schedules may generate more useful information than more temporally-spaced inventories. More information about system implementation, use, and benefits could be generated, perhaps at the expense of synoptic information about the status of data.

The incentive for state coordinators provided with the NFS – $1,000/state – was criticized by a many contacts as inadequate. It was noted that even for small states, this did not cover costs associated with the survey. On the assumption that funding of sufficient magnitude to cover a nation-wide survey is unlikely to come solely from federal sources, partnerships will need to be created. State and federal agencies may have similar information requirements, and use this as a basis for collaboration. Corporate sources of support should also be explored; with some minor adjustments, a nationwide survey could be of tremendous value in marketing goods and services.

Mistrust of higher units of government will need to be alleviated before a survey can be successful in many parts of the country. We heard the term "unfunded mandate" from more than one respondent. No single solution will allay this issue, although creation of partnerships with common goals is one general path. At the very least, survey coordinators need to be very clear about why the information is being collected and how

it will be used. Local governments in particular, are concerned about use of information by the private sector and higher levels of government. To the extent possible, local units of government should be involved in survey question development. Professional associations and software users groups can play a very important role in this coordination and in alleviating fears of misuse of data.

Another approach to better participation is monetary incentives or penalties. In Wisconsin, we have tied state GIS development grants to participation in the annual survey. Other states which have state shared revenues related to local technology implementation may be able to create similar requirements. New Mexico used benefits associated with commercial software as an incentive. Again, flexibility and creativity will be needed to provide appropriate incentives in any given state.

Other Observations from the Wisconsin Experience

A number of choices about how to implement the Wisconsin survey seem to have helped engender on-going support for it. These include making it an annual process, providing tools to access and understand results, and plans to link it with the state's data clearinghouse.

The Wisconsin survey has been "institutionalized" – state and county agencies know it must be part of their work each year. The state's budget always includes funding and staffing to conduct the survey. How the survey will be implemented and when completion is required are clear. Counties recognize that staff time will be devoted to this, reducing antipathy when it shows up.

The Website that reports Wisconsin Land Information Program (WLIP) survey results has been designed to support queries of the data, at both county and aggregate levels. This helps to build support among a user community for the activity and provides data to support the WLIP. While the NFS provided some basic ArcView tools to unpack and display NFS results, only knowledgeable ArcView users could query the attribute. A combination of graphic and query-support tools would be ideal.

Wisconsin is in an initial phase of designing a statewide land information system (WLIS – Wisconsin Land Information System). The system will be a confederation of state and local web-nodes that provide access to data from all units of government. A core component of this will be an FGDC-type data clearinghouse (WiscLINC), with metadata and access information for 1000s of locally generated data sets. Traditionally, clearinghouses have operated on a voluntary basis; agencies provide data as they are able (and have time to write metadata descriptions). Under an evolving concept for WLIS, the annual inventory of county data for the Wisconsin Land Information Program would provide a mechanism to update WiscLINC. Additional questions about access procedures, costs, and so forth may need to be added, but the vision of WLIS is to provide the software infrastructure necessary to facilitate conversion and acquisition of data through a single interface.

Of course, in thinking about a process to generate nation-wide data, it must be remembered that not all states are as oriented toward local land records modernization as Wisconsin. Moreover, Wisconsin has relatively high levels of state and local taxes, with a concomitant high level of governmental services. In other words, the Wisconsin strategy cannot be expected to work everywhere. Approaches that generate sufficient information for state and national needs may look very different in "low tax" states.

Summary

With the passage of more time, antipathy surrounding the 1997-8 NFS effort hopefully will have dissipated. Many states will have their own efforts underway. Web-based approaches will be tried and true. At that point, FGDC, NSGIC and organizations with reach to the local level such as NACO should consider how to track the status of GIS implementation and framework data development at local levels. The University Consortium goal for Geospatial Information Sciences has identified this as a necessary and useful, to better understand the interaction of GIS and society. It clearly would benefit public agencies at many levels and private concerns as well. However, if the effort is mounted, much greater attention needs to be focused on creating a survey process and sampling frame that engenders more complete participation.

The main recommendations from our inventory of state NFS coordinators and other contacts, and the Wisconsin WLIP survey include:

- involvement of state and local representatives in selection of questions to ensure relevancy and buy-in;

- identification of a limited set of "core" questions of national interest, to be nested in state, regional, or sectorial surveys;

- development of fully Web-enabled approaches (not just Web-download of traditional survey forms), including linkage to data base and additional/explanatory materials. Should include multiple forms for distribution (e.g., CDs and diskettes in addition to Web-site based);

- annual or transactional inventory, so updating status of data is routine agency function, not occasional effort;

- survey frame and sample structure developed ahead of time, targeted to appropriate agencies. Could include consideration of a statistical sample based approach, particularly in large and populous states;

- reasonable and sufficient monetary incentives to generate adequate response rates, coupled with clear "use of results" benefits stream;

- linkage of survey with other state and federal initiatives, such as statewide land information systems and data clearinghouses.

V. References

FGDC Framework Survey website
http://www.fgdc.gov/framework/survey_results/readme.html

FGDC Framework Data Survey Update Questionnaire
http://www.fgdc.gov/framework/survey_results/update.html

Arkansas State Land Information Board Framework Data Survey
http://www.dis.state.ar.us/gissrvy/gis-login.asp

Indiana GIS Initiative
http://www.polis.iupui.edu/ingisi/survey

Louisiana GIS Resource Inventory
http://lagic.lsu.edu/

Michigan Geographic Resources Inventory
http://www.state.mi.us/mgic_survey/mgri.asp

Michigan Geographic Information Clearinghouse
http://www.state.mi.us/dmb/mic/gis/clearinghouse.htm

Hydrography Committee of the Minnesota Governor's Council on Geographic Information
http://www.gis.state.mn.us/committee/hydro/hydro.htm/

New Hampshire GRANIT Website
http://www.granit.sr.unh.edu/

New Jersey Clearinghouse Website
http://njgeodata.state.nj.us/

Pennsylvania MAGIC 1999 Survey Results
http://www.pamagic.org/survey/survey1999.htm

Virginia Geographic Information Network (VGIN)
www.vgin.state.va.us

Wisconsin Land Information Program Assessment Survey Home Page
http://www.doa.state.wi.us/olis/wlip/survey2000/Index.asp