

U.S. Public-Sector GIS Survey: Key Issues and Trends

Gartner's 2002 U.S. public-sector geographic information system survey results highlight common issues facing government GIS managers.

Management Summary

Geospatial technology and geographic information systems (GISs) continue to grow and expand in multiple subdivisions of government organizations. Traditional government back-office systems began with centralized management. Over time, this management has swung like a pendulum to a decentralized model. In many cases, it has returned to centralized management.

GIS management has taken a different course. It began in departmental subdivisions, such as public works, where it has been ingrained in day-to-day operations. The value of geospatial data and systems has become increasingly important to government organizations. GIS data and system availability, in addition to these systems' inherent data aggregation and visualization capabilities, also accentuate the previously blurred lines between various government tiers. In addition, public policy is being shaped by the availability of high-quality geospatial data. This increasing emphasis highlights the need for coordination, collaboration and an enterprise view of GIS management.

Gartner recently surveyed U.S. federal, state and local government GIS managers to determine the current and planned status of GIS management environments, and to test our assertions regarding different issues facing government GIS managers. We recognized recurring patterns from our research and client interactions, and we wanted to identify the most-pressing issues facing government organizations in managing geospatial data and systems. We will tailor our future research agenda to address these issues.

The results and analysis of our public-sector GIS survey will interest government GIS managers in centralized and decentralized environments, CIOs, and administrative officials that have overall line-of-business responsibility for organizations that create and maintain spatially referenced data and geospatial systems.

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U.S. Public-Sector GIS Survey: Key Issues and Trends

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CONTENTS

- 1.0 GIS Survey Respondents, Key Issues and Trends5
- 2.0 Enterprise GIS Management6
 - 2.1 Enterprise vs. Agency-Specific GIS.....6
 - 2.2 Infrastructure7
 - 2.3 Platform and Network Hosting.....7
 - 2.4 Management (Excluding Hosting).....8
 - 2.5 Infrastructure Issues9
 - 2.6 Governance Structure9
 - 2.7 Software and Data Standards Implementation and Accuracy10
 - 2.8 Trends and Action Items11
- 3.0 GIS Application Integration and Development.....12
 - 3.1 Integration Methods.....12
 - 3.2 Wireless Device Integration13
 - 3.3 In-House Application Development13
- 4.0 GIS Software, Vendor, Product and Standards Issues.....14
 - 4.1 Software14
 - 4.2 Vendors and Products.....15
 - 4.3 Open GIS Consortium Standards15
- 5.0 GIS-Enabled Data Access16
 - 5.1 Internet-Based, Real-Time Public Access16
 - 5.2 Data Fees.....18
 - 5.3 Data Accuracy Liability.....19
 - 5.4 Action Items21
- 6.0 GIS Budgets, Staffing and Financials.....21
 - 6.1 Software Budget21
 - 6.2 Hardware Budget23
 - 6.3 Staffing25
 - 6.4 Financial Analysis.....28
 - 6.5 Justifying GIS Operations28
- 7.0 Summary and Recommendations.....29
- Appendix A: Acronym Key30

FIGURES

Figure 1. GIS Survey Respondent Distribution5

Figure 2. Enterprise GIS Respondents' Organizations6

Figure 3. Enterprise vs. Agency-Specific GIS Infrastructure7

Figure 4. GIS Hosting8

Figure 5. GIS Management.....8

Figure 6. GIS Infrastructure Issues9

Figure 7. GIS Governance Structure10

Figure 8. Software and Data Standards Implementation10

Figure 9. Software and Data Standards and Accuracy Issues11

Figure 10. GIS Application Integration Progress12

Figure 11. GIS Application Integration Methods13

Figure 12. GIS Wireless Device Implementation13

Figure 13. GIS In-House Application Development.....14

Figure 14. GIS Software Vendor Presence15

Figure 15. GIS Vendor and Product Issues15

Figure 16. Open GIS Consortium Standards16

Figure 17. GIS-Related Real-Time Public Information17

Figure 18. Maps/Data Fee Legislation18

Figure 19. Maps/Data Fees.....18

Figure 20. Maps/Data Charge Models19

Figure 21. Data Accuracy Liability20

Figure 22. GIS Liability Issues.....21

Figure 23. FY02 GIS Software Budget.....22

Figure 24. FY03 GIS Software Budget (Projected)23

Figure 25. FY02 GIS Hardware Budget24

Figure 26. FY03 GIS Hardware Budget (Projected)25

Figure 27. GIS Government and Contracted Full-Time Equivalents26

Figure 28. FY02 GIS Staffing Budget26

Figure 29. FY03 GIS Staffing Budget (Projected).....27

Figure 30. GIS Staffing Issues27

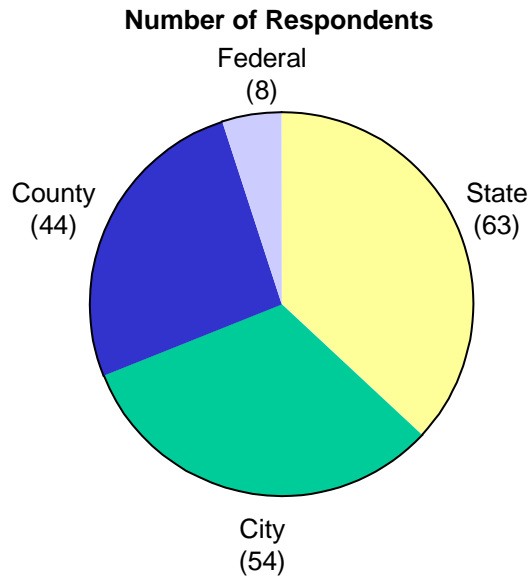
Figure 31. GIS Financial Analysis Methods.....28

Figure 32. GIS Financial Justification28

U.S. Public-Sector GIS Survey: Key Issues and Trends

1.0 GIS Survey Respondents, Key Issues and Trends

Gartner's public-sector GIS survey had 169 respondents from federal, state, county and city agencies (see Figure 1).



Source: Gartner Research

Figure 1. GIS Survey Respondent Distribution

Most respondents were individuals who had titles similar to "GIS manager or coordinator." We sought respondents who had responsibility for their jurisdictions' GIS environment and could respond on behalf of their jurisdictions. In cases where GIS management was highly decentralized, respondents sometimes responded on the GIS environment in their agencies. Respondents mostly came from IS organizations, departments of transportation and public works, planning, environmental resources, and public utilities agencies.

The key issues and trends that we gleaned from the survey results are:

- There is clearly a trend to migrate disparate line-of-business geospatial systems to an enterprise GIS environment. This trend features core GIS infrastructure management by a central IS organization, with data management responsibilities held by the lines of business that are the primary users.
- The legacy environment that features disparate geospatial systems has created several significant barriers to migrating to enterprise GIS:
 - Government business units have varying base-map and other data accuracy requirements, which may manifest in duplicative systems and no sharing of information.
 - Data sharing among tiers of government — for example, municipal-to-county or local-to-federal — often is problematic. Data standards and accuracy, as well as funding issues, often are at the center of these problems.
 - The powerful data aggregation and visualization features of GISs enable them to incorporate data from other systems. Systems integration issues ranked high on survey respondents' lists of issues.
 - Strong governance is lacking. Although the majority of respondents have some sort of governance structure to support cross-department GISs, few have governance structures that are authoritative.

U.S. Public-Sector GIS Survey: Key Issues and Trends

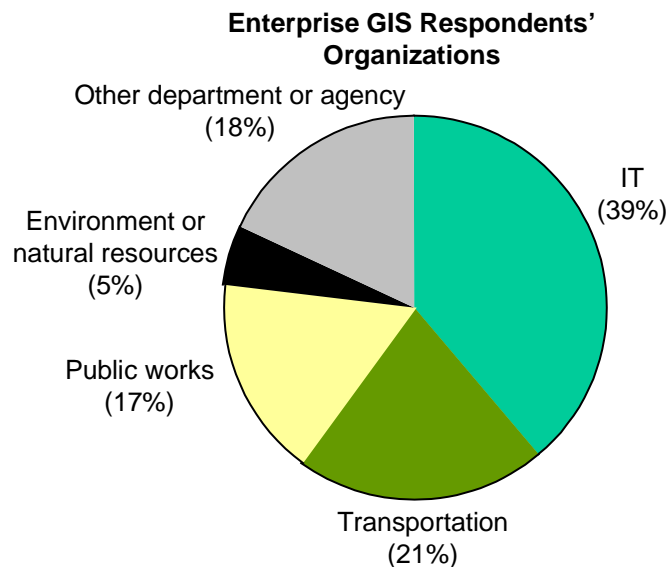
The best governance structures feature a collaborative environment with representation from all relevant business units. These business units have the authority to mandate change for the entire jurisdiction.

- There is a significant presence of geospatial data and system access via the Internet. Although we don't have baseline data from previous years, we believe that geospatial data and systems access via the Internet will expand as a way to improve constituent service and operational efficiency, enhance interagency communications, and bolster economic development.
- Respondents are grappling with maintaining constituent privacy while increasingly making more aggregated information available online.
- Almost all respondents used Environmental Systems Research Inc. (ESRI) products to some degree, with ESRI products comprising approximately two-thirds of their GIS software budgets.
- A tough economy is making it difficult to justify new and ongoing geospatial initiatives. In 2003, on average, GIS budgets will not increase. It is increasingly important to demonstrate business value (for example, value for money) to justify initiatives.
- Product lock-in, perceived forced migration to product releases and difficulty in forecasting feature enhancements were cited as key issues by respondents. They were not quantitatively linked to specific vendors.
- Open GIS Consortium (OGC) standards were viewed as somewhat to extremely important by more than 75 percent of respondents.

2.0 Enterprise GIS Management

2.1 Enterprise vs. Agency-Specific GIS

Seventy-three percent of respondents viewed their GISs as enterprisewide — that is, the GIS supports all subdivisions of a jurisdiction, regardless of whether infrastructure and data management are centralized or decentralized. These respondents report to various business units (see Figure 2).



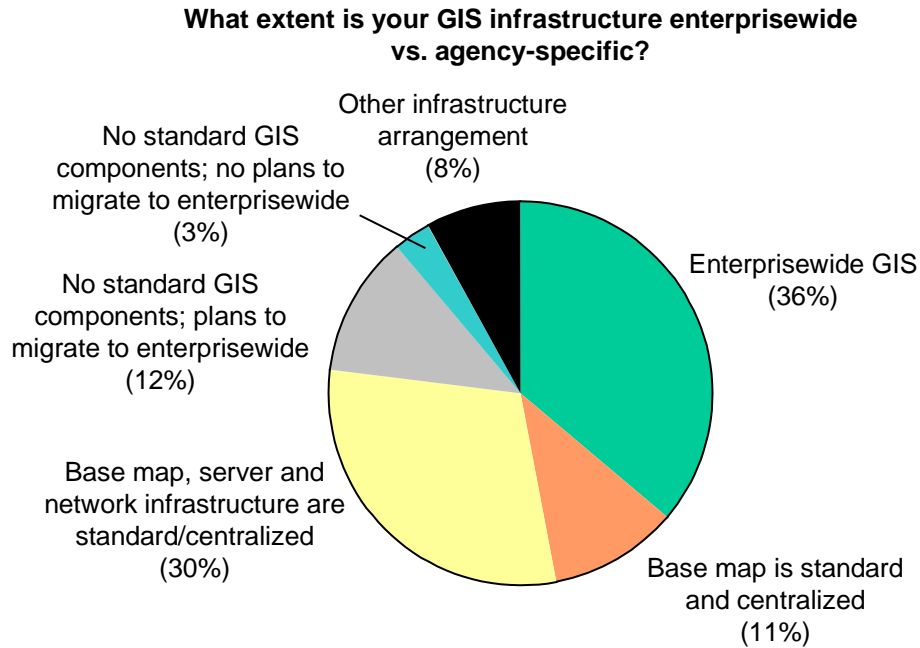
Source: Gartner Research

Figure 2. Enterprise GIS Respondents' Organizations

U.S. Public-Sector GIS Survey: Key Issues and Trends

2.2 Infrastructure

Figure 3 shows the extent to which respondents' GIS infrastructure is enterprisewide vs. agency-specific.



Source: Gartner Research

Figure 3. Enterprise vs. Agency-Specific GIS Infrastructure

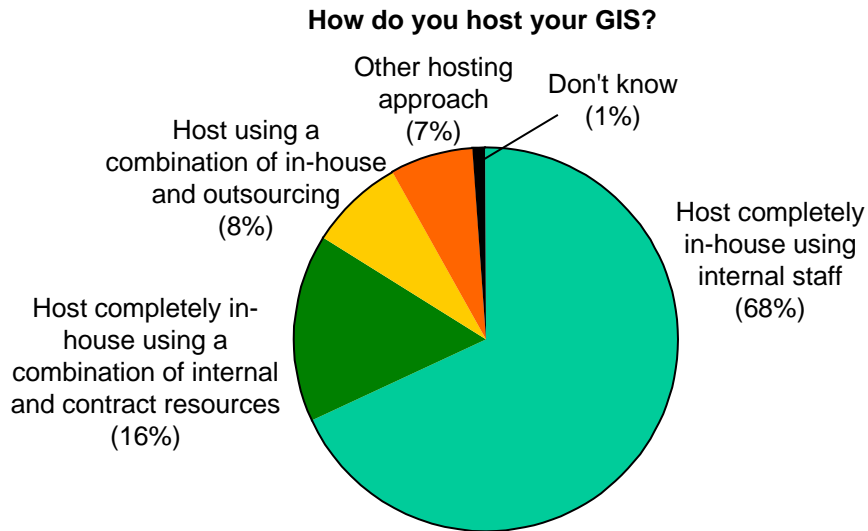
Noteworthy examples of "other infrastructure arrangements" include:

- Consortiums of regional government jurisdictions that have interconnected infrastructure to support all of the jurisdictions' data and base maps.
- Multiple agencies within a jurisdiction that are custodians of the data that they produce. These data sets are coordinated through a central hub or clearinghouse.

2.3 Platform and Network Hosting

Eight-four percent of respondents host their GIS platforms and networks in-house — 68 percent only use government staff, and 16 percent use a combination of government and contracted staff. Fifteen percent outsource all or a portion of their GIS platforms and networks (see Figure 4).

U.S. Public-Sector GIS Survey: Key Issues and Trends



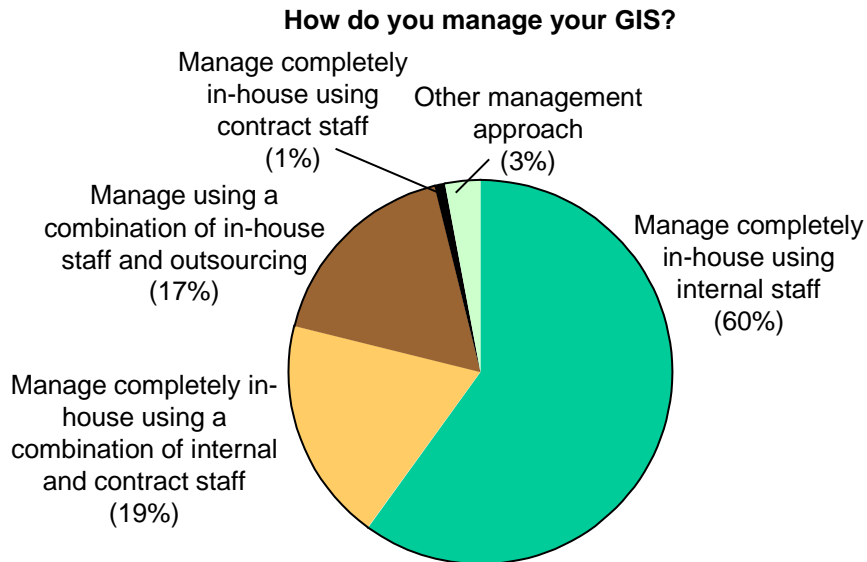
Source: Gartner Research

Figure 4. GIS Hosting

For 2003, the percentage of respondents who plan to host a GIS by using only in-house staff dropped to 63 percent; 18 percent expect to use a combination of government and contracted staff. Eighteen percent plan to outsource all or a portion of their GIS platforms and networks in 2003.

2.4 Management (Excluding Hosting)

Figure 5 shows how respondents manage their GISs.



Source: Gartner Research

Figure 5. GIS Management

Although respondents indicated that they will use more contract GIS management staff in 2003, most will manage their GISs in-house next year. They also indicated that there will be a 3-percent reduction in the use of a combination of in-house and outsourced GIS management.

U.S. Public-Sector GIS Survey: Key Issues and Trends

2.5 Infrastructure Issues

Respondents were asked to rate a list of infrastructure issues on the importance of resolving the issue using a scale of 1 ("Not Important at All") to 5 ("Extremely Important"). Respondents also could respond that the issue was not applicable (N/A) to them (see Figure 6).

Issue	Percent Responding N/A*	Mean of 1-to-5 Responses**
Different base-map accuracy standards among divisions of the jurisdiction	18%	3.7
Different base-map accuracy standards among respondent's jurisdiction and other jurisdictions for which data was shared	12%	3.7
Other interjurisdiction barriers to sharing data	10%	3.9
Duplicative intrajurisdiction infrastructure maintained where cost to maintain exceeds benefit	23%	3.4
Duplicative interjurisdiction infrastructure maintained where cost to maintain exceeds benefit	21%	3.4
Integration with internal systems	5%	4.2
Integration with mobile environments	9%	3.2
*Not applicable to respondent **Scale of 1 ("Not Important at All") to 5 ("Extremely Important")		

Source: Gartner Research

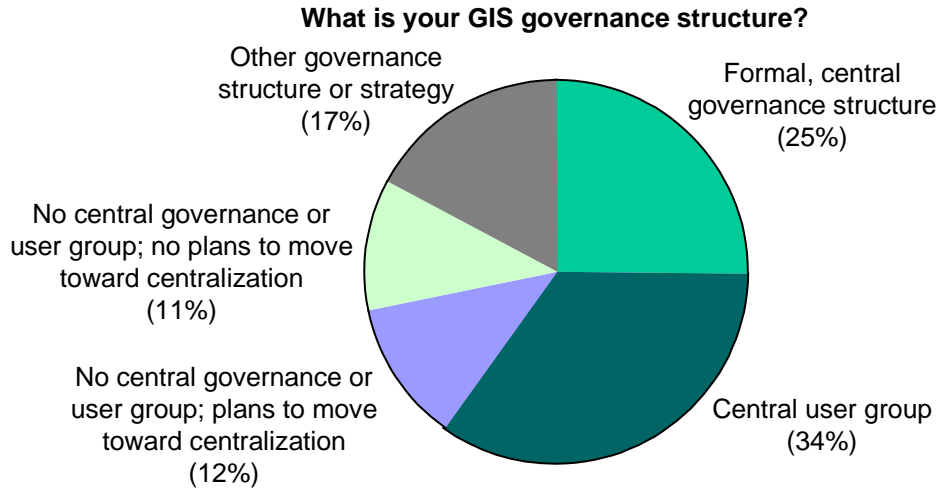
Figure 6. GIS Infrastructure Issues

On average, the mean values for these issues were 0.3 higher for respondents who did not have an enterprise GIS. All issues, with the exception of "integration with internal systems," had higher mean values for respondents that did not have an enterprise GIS.

2.6 Governance Structure

Respondents were asked to select the structure that best described the formal oversight or coordination of GIS activities within the jurisdiction (see Figure 7).

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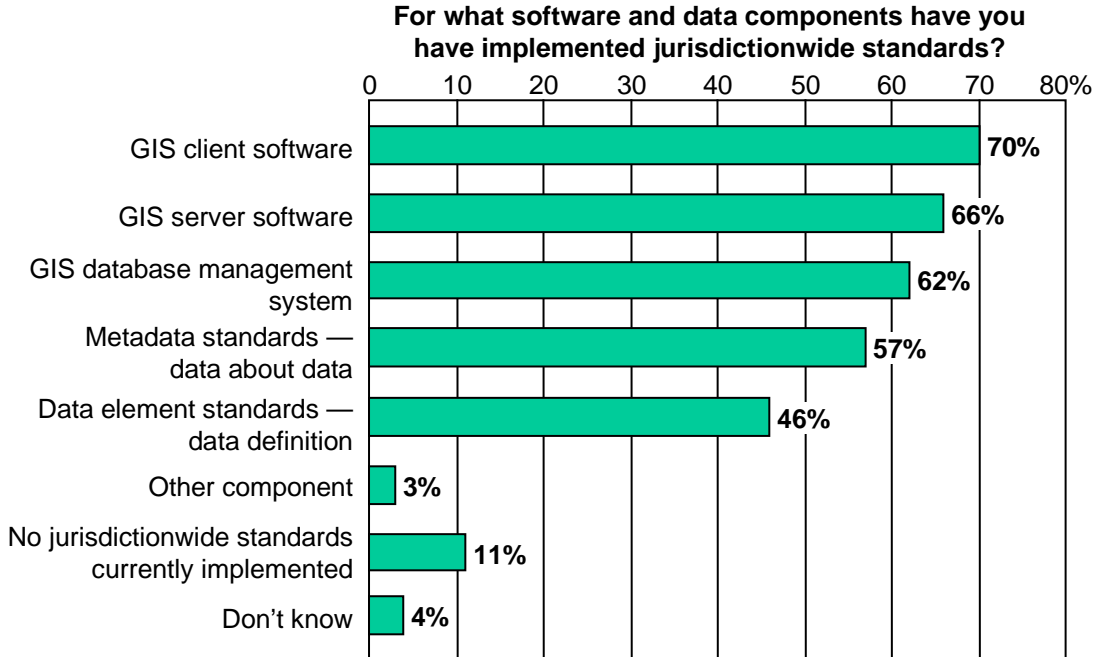
Source: Gartner Research

Figure 7. GIS Governance Structure

Government organizations that are experiencing difficulty in implementing enterprise initiatives, not just GIS projects, typically do not have a strong IT governance structure that features collaborative involvement of lines of business and the authority to mandate change.

2.7 Software and Data Standards Implementation and Accuracy

Respondents were asked what jurisdictionwide standards have been implemented for software- and data-related items (see Figure 8).



Source: Gartner Research

Figure 8. Software and Data Standards Implementation

Respondents also were asked to rate a list of software and data standards issues on the importance of resolving the issue (see Figure 9).

U.S. Public-Sector GIS Survey: Key Issues and Trends

Issue	Percent Responding N/A*	Mean of 1-to-5 Responses**
Lack of software standards within your jurisdiction	26%	2.8
Lack of software standards between your jurisdiction and other jurisdictions	13%	2.9
Lack of data standards within your jurisdiction	18%	3.7
Lack of data standards between your jurisdiction and other jurisdictions	5%	3.5
Lack of metadata standards within your jurisdiction	18%	3.5
Lack of metadata standards between your jurisdiction and other jurisdictions	8%	3.3
Data accuracy variations among user subdivisions	10%	3.7
Data format differences among different vendors' products	13%	3.2
Other software/data standards issues	80%	3.3
*Not applicable to respondent **Scale of 1 ("Not Important at All") to 5 ("Extremely Important")		

Source: Gartner Research

Figure 9. Software and Data Standards and Accuracy Issues

2.8 Trends and Action Items

Historically, the GIS function grew within agency lines of business that had direct and apparent need for this functionality. Thirty-nine percent of respondents stated that the enterprise GIS role is reporting to the IS organization. Twelve percent of respondents who do not have a centralized infrastructure are planning to move to centralize this infrastructure. The need for geospatial data is permeating government, with local government having an accentuated need for integrating geospatial data into multidepartment operations.

An enterprise focus reduces the number of issues regarding data accuracy, quality and standards. The importance of resolving standards issues was lower (an average of 0.3 on a five-point scale) when the respondent reported that the GIS function was enterprisewide. Also, on average, the percentage of respondents that responded "not applicable" to an issue was 4.4 percent higher for those organizations that had an enterprise GIS function.

The extent that the jurisdiction has a collaborative environment or a strong governance structure will determine the composition of centralized vs. decentralized data management. Varying accuracy requirements among subdivisions may subvert efforts to enhance efficiencies.

Governments should:

- Consolidate GIS infrastructure operations. Data management and support should be a hybrid of centralized/decentralized management. Infrastructure, such as servers, the network components that

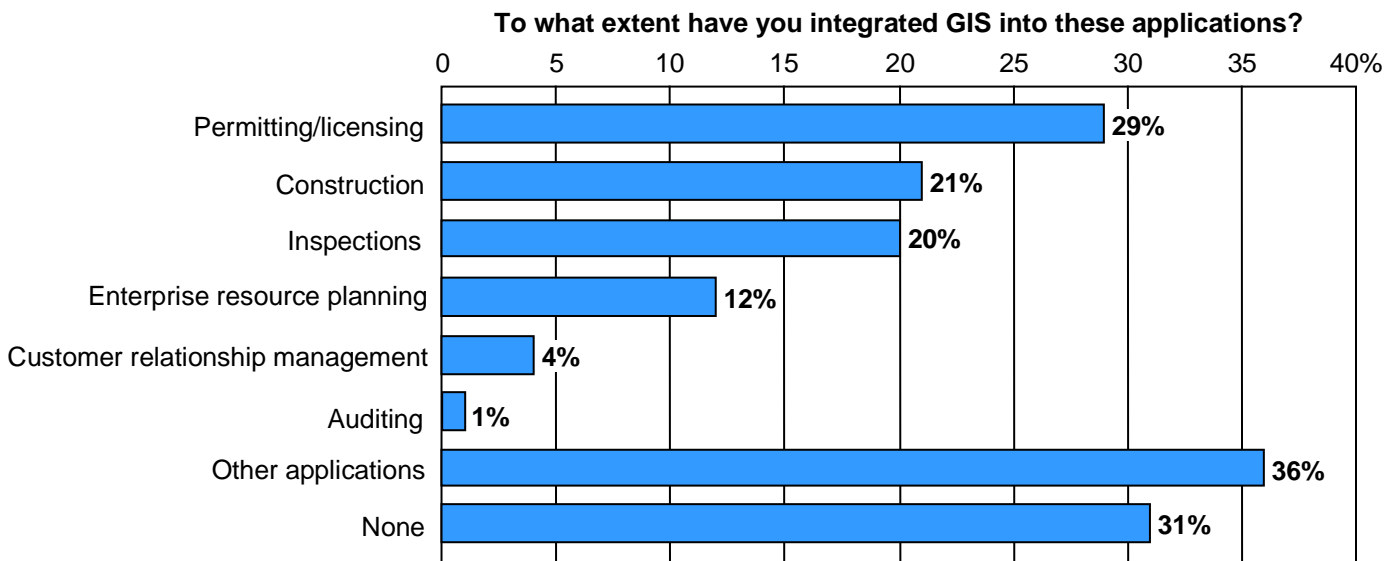
U.S. Public-Sector GIS Survey: Key Issues and Trends

support those servers, base maps, enterprise applications and multiagency-shared data, usually can be managed most efficiently by one organization.

- Leverage authoritative governance structures comprising business-unit representatives by using subdivisions to facilitate cooperation and collaboration regarding data standards and accuracy requirements, and to avoid duplicative infrastructure.
- Establish or strengthen interjurisdictional relationships and collaborative agreements to mitigate data- and application-sharing issues. Include representatives from collaborating jurisdictions in authoritative governance structures.

3.0 GIS Application Integration and Development

Figure 10 shows the extent that respondents have integrated various types of applications with GIS functionality.



Source: Gartner Research

Figure 10. GIS Application Integration Progress

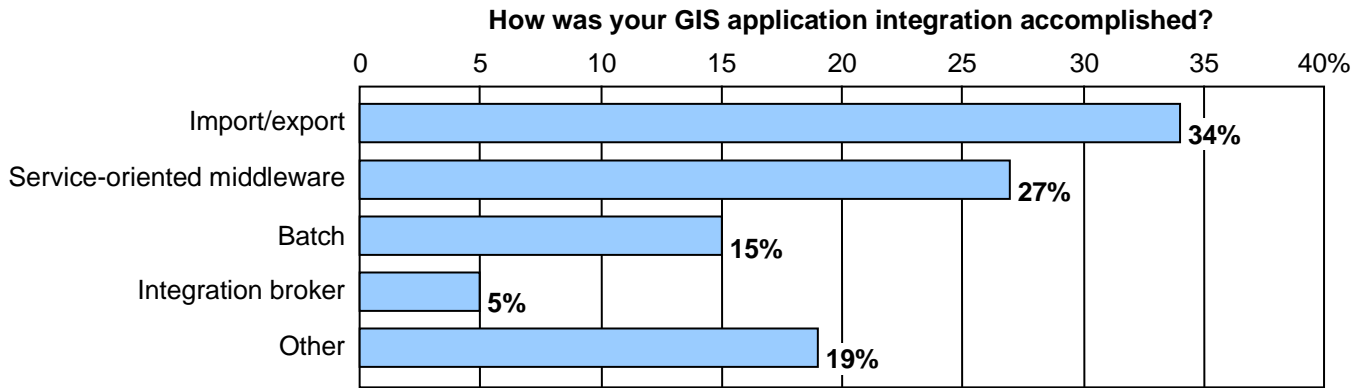
The most-prevalent answers to "other applications" were:

- Facilities management
- Law enforcement and public safety (dispatch systems)
- Road maintenance
- Work order systems
- Property/land management
- Public transit
- Economic development

3.1 Integration Methods

Figure 11 shows how integration across applications was accomplished.

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Source: Gartner Research

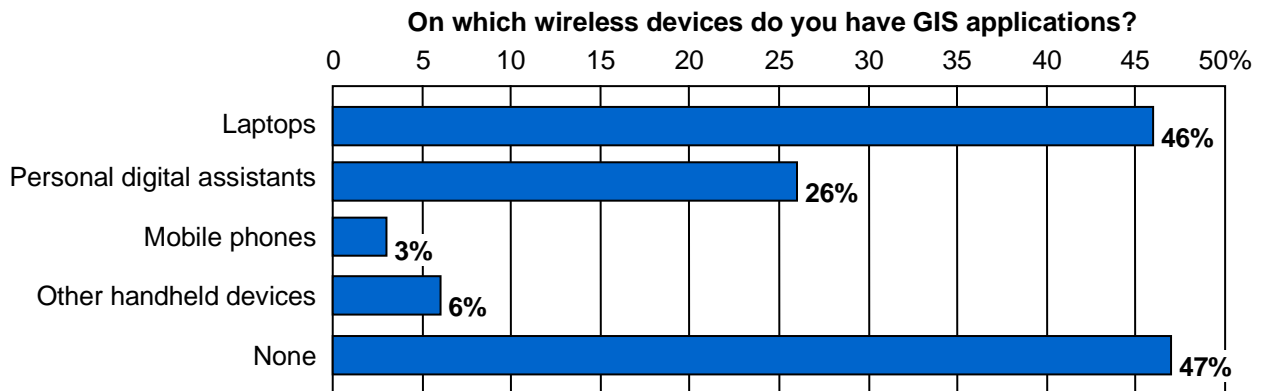
Figure 11. GIS Application Integration Methods

The most-prevalent answers to "other" were:

- Database integration
- Native GIS application integration capabilities

3.2 Wireless Device Integration

Figure 12 shows the wireless devices on which respondents currently have GIS applications.



Source: Gartner Research

Figure 12. GIS Wireless Device Implementation

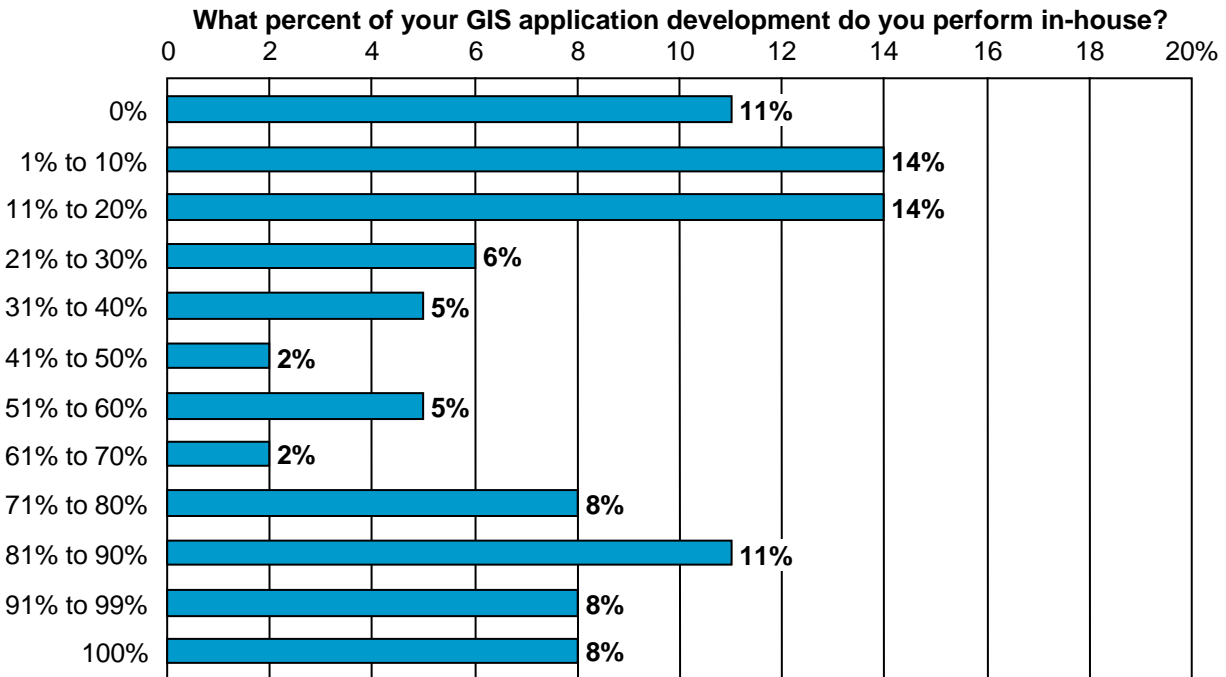
Wireless device integration is becoming increasingly prevalent, with an emphasis on laptops and personal digital assistants that are used in fieldwork.

More than two-thirds of respondents have integrated other applications besides wireless devices with GIS functionality. However, achieving that integration is cited as a significant issue (see Figure 6).

3.3 In-House Application Development

Respondents were asked to what percent they performed GIS application development in-house (see Figure 13).

U.S. Public-Sector GIS Survey: Key Issues and Trends



Source: Gartner Research

Figure 13. GIS In-House Application Development

4.0 GIS Software, Vendor, Product and Standards Issues

4.1 Software

Figure 14 lists the percentage of respondents who had a vendor's software (that is, a presence in the jurisdiction of the vendor's products) and the estimated percentage of the GIS software purchase and maintenance budget that is allocated to those products. We realize that several of these vendors are more known for their database or computer-aided design (CAD) background than for GIS functionality, which may have skewed the results of this particular question. Respondents may have more products from traditional CAD vendors in their jurisdictions, but did not include them in this response because the CAD products are not used as part of the GIS infrastructure. However, it is becoming increasingly common for traditional CAD and GISs to converge in product functionality and implementations.

U.S. Public-Sector GIS Survey: Key Issues and Trends

Vendor	Presence	% of Software Purchase, Maintenance Budget
ESRI	95%	67%
Oracle	36%	5.7%
Autodesk	26%	3.6%
Intergraph	21%	6.1%
ERDAS	19%	1.3%
MapInfo	16%	1.4%
Bentley Systems	13%	2%
GE Smallworld	1%	none
Enghouse Systems	none	none
Other GIS vendor	14%	9%

Source: Gartner Research

Figure 14. GIS Software Vendor Presence

4.2 Vendors and Products

Respondents were asked to rate a list of vendor and product issues on the importance of resolving the issue (see Figure 15).

Issue	Percent Responding N/A*	Mean of 1-to-5 Responses**
Forecasting future GIS vendor viability	10%	3
Forecasting the future of GIS product features	5%	3.8
Being forced to migrate products because of vendor upgrades and discontinued support for older versions	9%	4
Product lock-in	12%	3.5

*Not applicable to respondent
**Scale of 1 ("Not Important at All") to 5 ("Extremely Important")

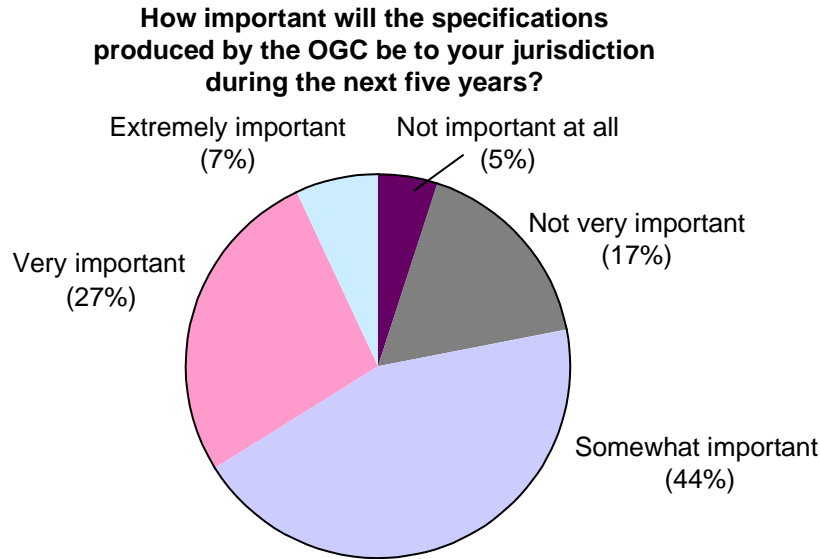
Source: Gartner Research

Figure 15. GIS Vendor and Product Issues

4.3 Open GIS Consortium Standards

Respondents were asked how important OGC standards would be to their jurisdictions during the next five years (see Figure 16).

U.S. Public-Sector GIS Survey: Key Issues and Trends



Source: Gartner Research

Figure 16. Open GIS Consortium Standards

The combination of strong sentiment for resolving the vendor and product issues in Figure 15, and the fact that 78 percent of respondents stated that OGC standards were somewhat to extremely important, indicates that product interoperability is a critical issue for GIS managers.

Governments should use the aggregate buying power of jurisdictions and membership in the OGC to push vendors to increase support for open and interoperable GIS products.

5.0 GIS-Enabled Data Access

5.1 Internet-Based, Real-Time Public Access

Figure 17 shows which GIS-related information and services respondents provide to the public in real time via the Internet.

U.S. Public-Sector GIS Survey: Key Issues and Trends

GIS-Related Information/Services	% Offered Real Time
Land use or management	28%
Land ownership	28%
Census of other population demographics	22%
Economic development	19%
Taxation (property-tax information)	18%
Elections (precincts, poll locations, results)	18%
Road traffic management	18%
Public park management	17%
Flood management	15%
Environmental protection	14%
Fire or police precinct location	14%
Water or sewer utility	13%
Water resource management	12%
Public (nonschool) transportation management	11%
Crime control	9%
Emergency preparedness	9%
Real-estate development	9%
School district management	9%
Public health	8%
Soil management	8%
Fire management	7%
Employment (locations or statistics)	6%
Disaster recovery	5%
Public housing	5%
Telecommunications utility	5%
Air quality	4%
Forestry	4%
Tourism	4%
Electric utility	4%
Gas utility	2%
Other	20%
None of the above	38%

Source: Gartner Research

Figure 17. GIS-Related Real-Time Public Information

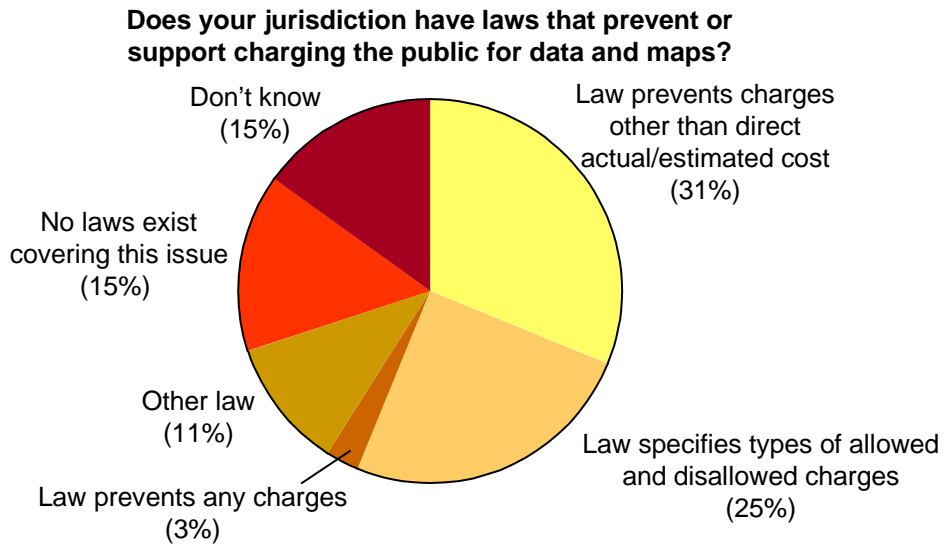
The most-prevalent responses to "other" were:

- Public facility location information
- Construction and detour reporting
- Other road maintenance reporting

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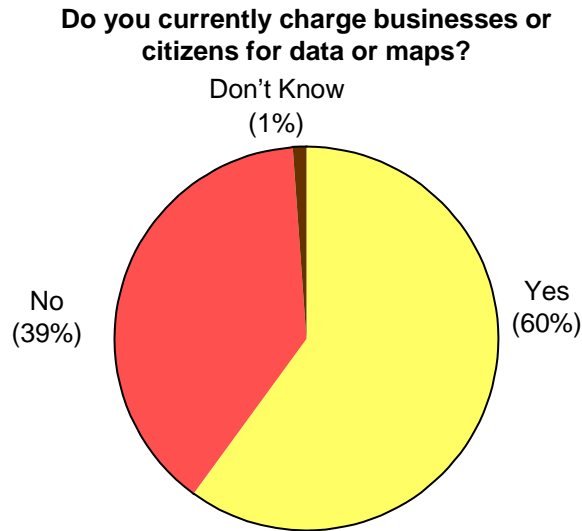
5.2 Data Fees

Respondents were asked about charging fees to the public for access to GIS data and maps (see Figure 18 and Figure 19).



Source: Gartner Research

Figure 18. Maps/Data Fee Legislation

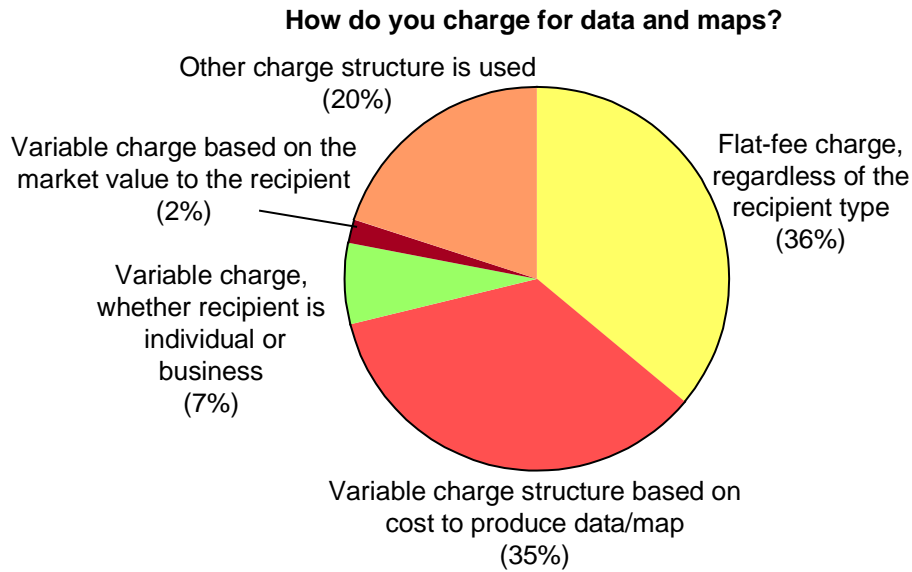


Source: Gartner Research

Figure 19. Maps/Data Fees

Of those respondents who answered "Yes" in Figure 19, 100 percent charge businesses and 95 percent charge citizens for maps and data access.

Those respondents who charge for data/maps were asked what type of charge model that they use (see Figure 20).



Source: Gartner Research

Figure 20. Maps/Data Charge Models

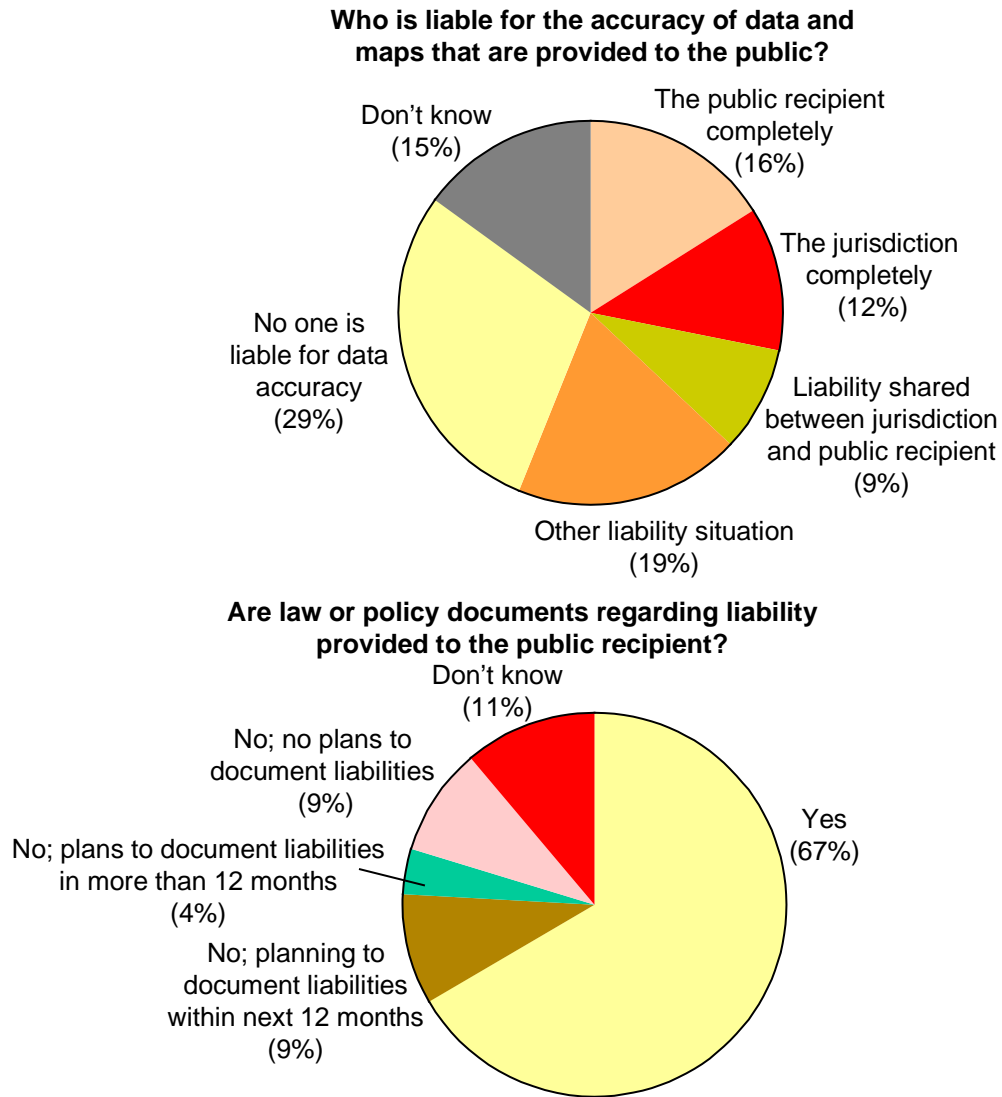
The majority of respondents' jurisdictions charge for data and maps. They do not differentiate charges based on businesses vs. citizens, or the value of the information to the customer.

Charging for data and map production can be a complex and contentious issue. Freedom of information laws, especially at the state and federal levels, can hinder the extent to which jurisdictions charge for data. In some respects, taxes pay for data collection and system management. However, governments often enter into agreements with private-sector organizations to provide data to the government — for example, private utilities or contractors. Direct-fee structures may be the only way to recover costs for this data when funding has not been appropriated and placed in budgets.

5.3 Data Accuracy Liability

Respondents were asked whether their jurisdictions' were liable for the accuracy of the GIS data, and whether they provided liability information to the public (see Figure 21).

U.S. Public-Sector GIS Survey: Key Issues and Trends



Source: Gartner Research

Figure 21. Data Accuracy Liability

The analysis of the numbered and verbatim responses from "other liability situation" indicate that most jurisdictions cover themselves against liabilities. Disclaimers often are used. However, some departments will take responsibility for the quality of data, but offer it "as is" with no warranties.

Respondents also were asked to rate a list data access and liability issues on the importance of resolving the issue (see Figure 22).

U.S. Public-Sector GIS Survey: Key Issues and Trends

Issue	Percent Responding N/A*	Mean of 1-to-5 Responses**
Determining the best method to charge for public access to maps or data	10%	2.8
Liability issues for data provided to the public	7%	3.2
Maintaining constituent privacy when providing GIS-based data via the Internet	15%	3.7
Conflict between the GIS and licensed surveyors	18%	2.7
Disintermediation (external service providers fulfilling the role of government in providing the public with GIS maps and data)	27%	2.4
Conflicts caused by physical resource boundaries (for example, rivers) that are not the same as jurisdiction boundaries	14%	2.5
*Not applicable to respondent **Scale of 1 ("Not Important at All") to 5 ("Extremely Important")		

Source: Gartner Research

Figure 22. GIS Liability Issues

5.4 Action Items

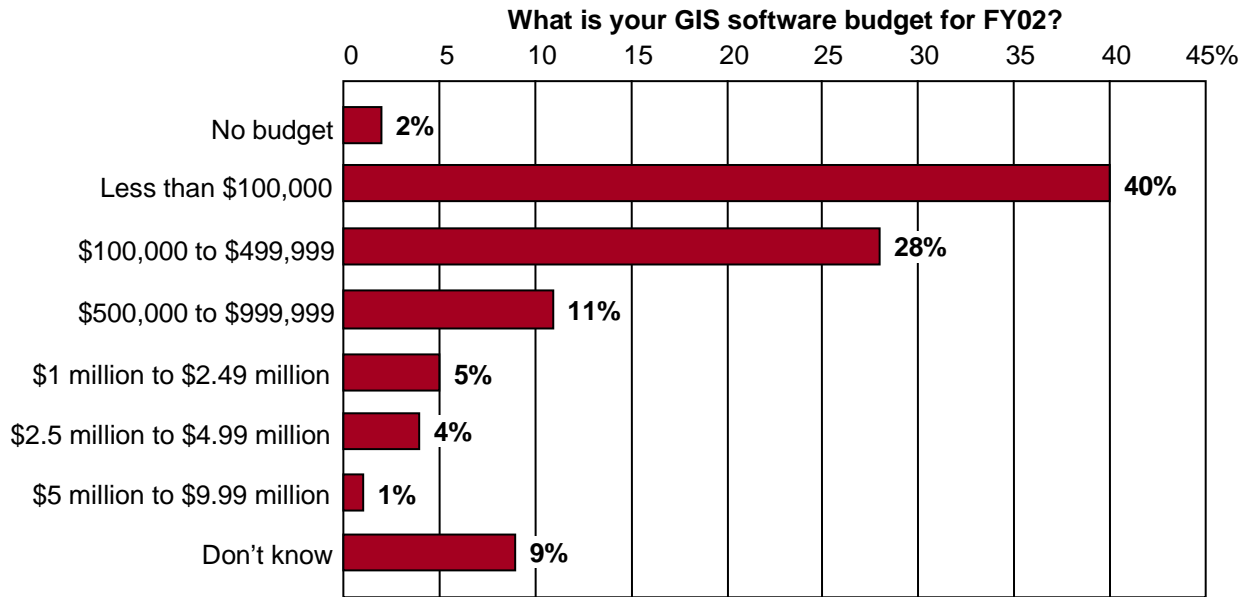
- Government organizations should charge for data and GIS access when value is added beyond customary access, and when the tax base does not pay for the costs of collection and distribution. Work to change laws that inhibit these activities. Alternatively, recognize and highlight costs that are associated with providing improved access to GISs to justify internal funding. Those organizations that don't or can't charge for access and data are at a disadvantage because they lose a source of funding.
- Government organizations should follow the jurisdiction's privacy laws and policies, and market those policies to create awareness. Use fair information practices in the absence of law containing notice, choice, access, transfer, integrity, security and enforcement practices. Required public access to personal information does not have to mean instant, anonymous access via the Internet.
- GIS managers and IT directors must work with legislatures and local councils to implement laws or policies that prevent the distribution of personal identifiers and sensitive information, particularly instant, anonymous Internet access. Consider identifying and authenticating individuals, even with in-person presentation, who request sensitive public data.

6.0 GIS Budgets, Staffing and Financials

6.1 Software Budget

Respondents were asked about their FY02 and projected FY03 GIS software budgets (see Figure 23 and Figure 24).

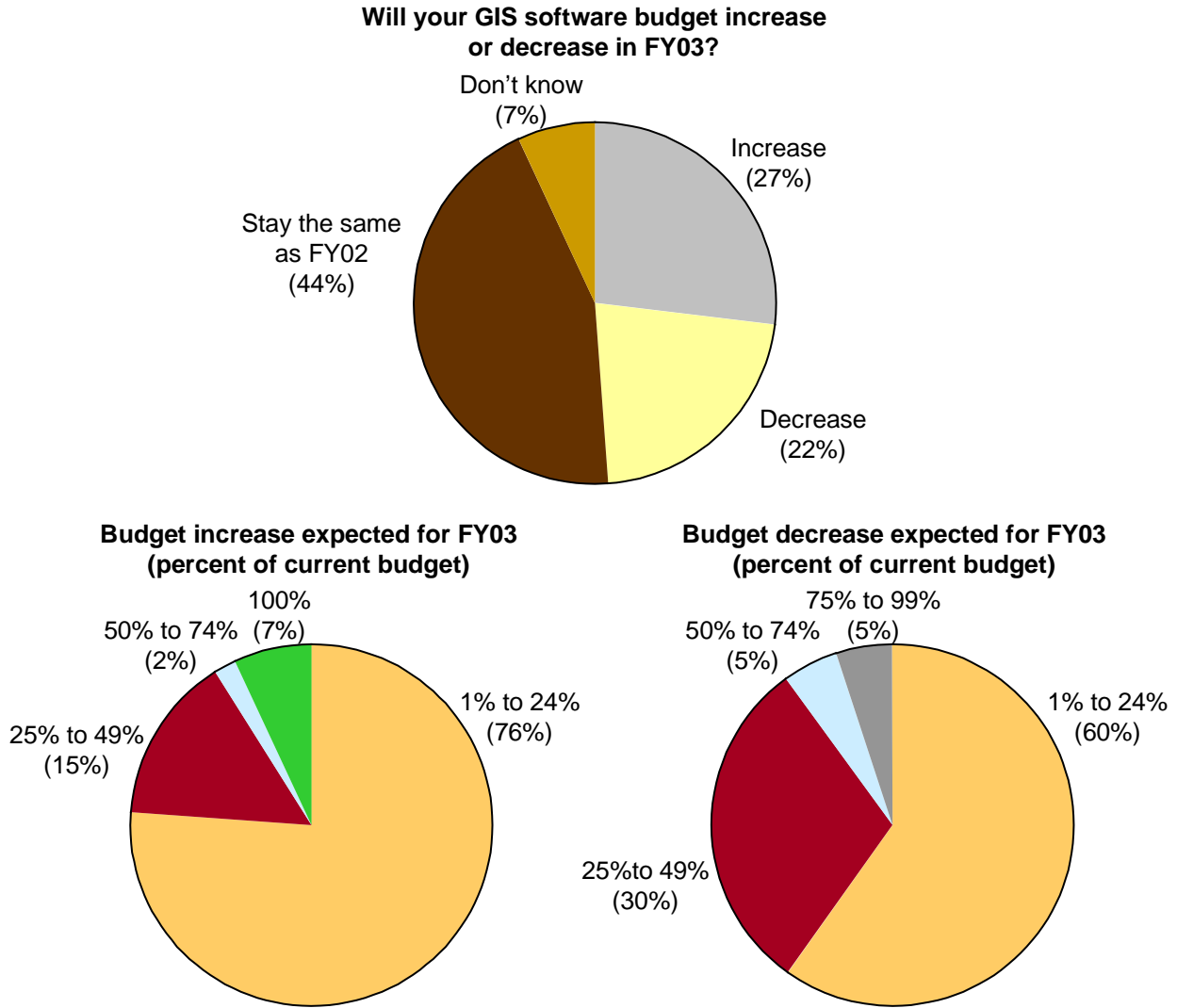
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Source: Gartner Research

Figure 23. FY02 GIS Software Budget

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Source: Gartner Research

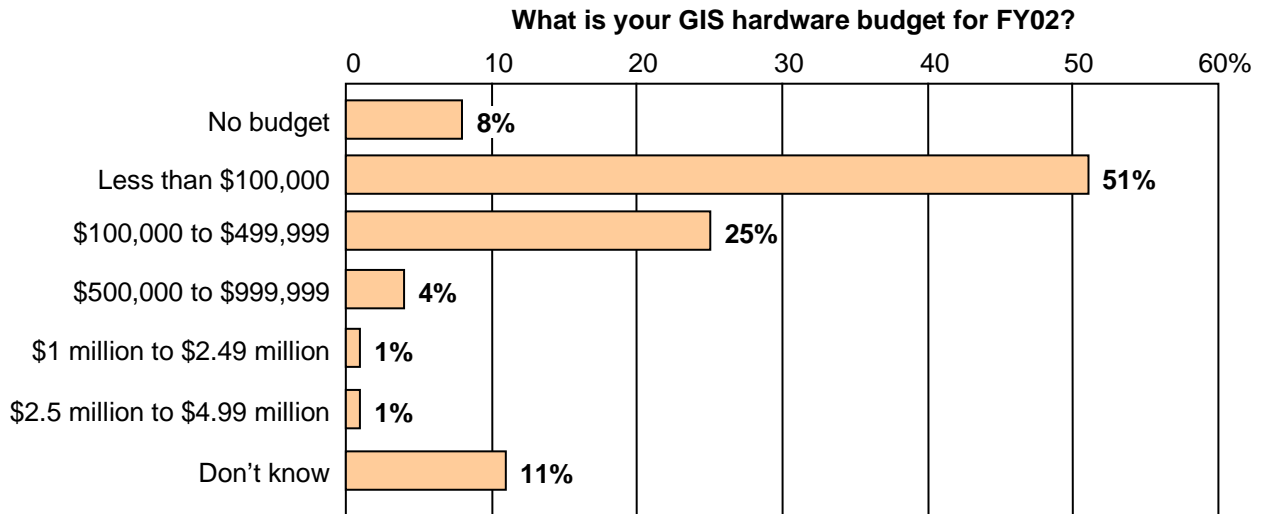
Figure 24. FY03 GIS Software Budget (Projected)

Overall, respondents do not expect to greatly increase their GIS software budgets in 2003.

6.2 Hardware Budget

Respondents were asked about their FY02 and projected FY03 GIS hardware budgets (see Figure 25 and Figure 26).

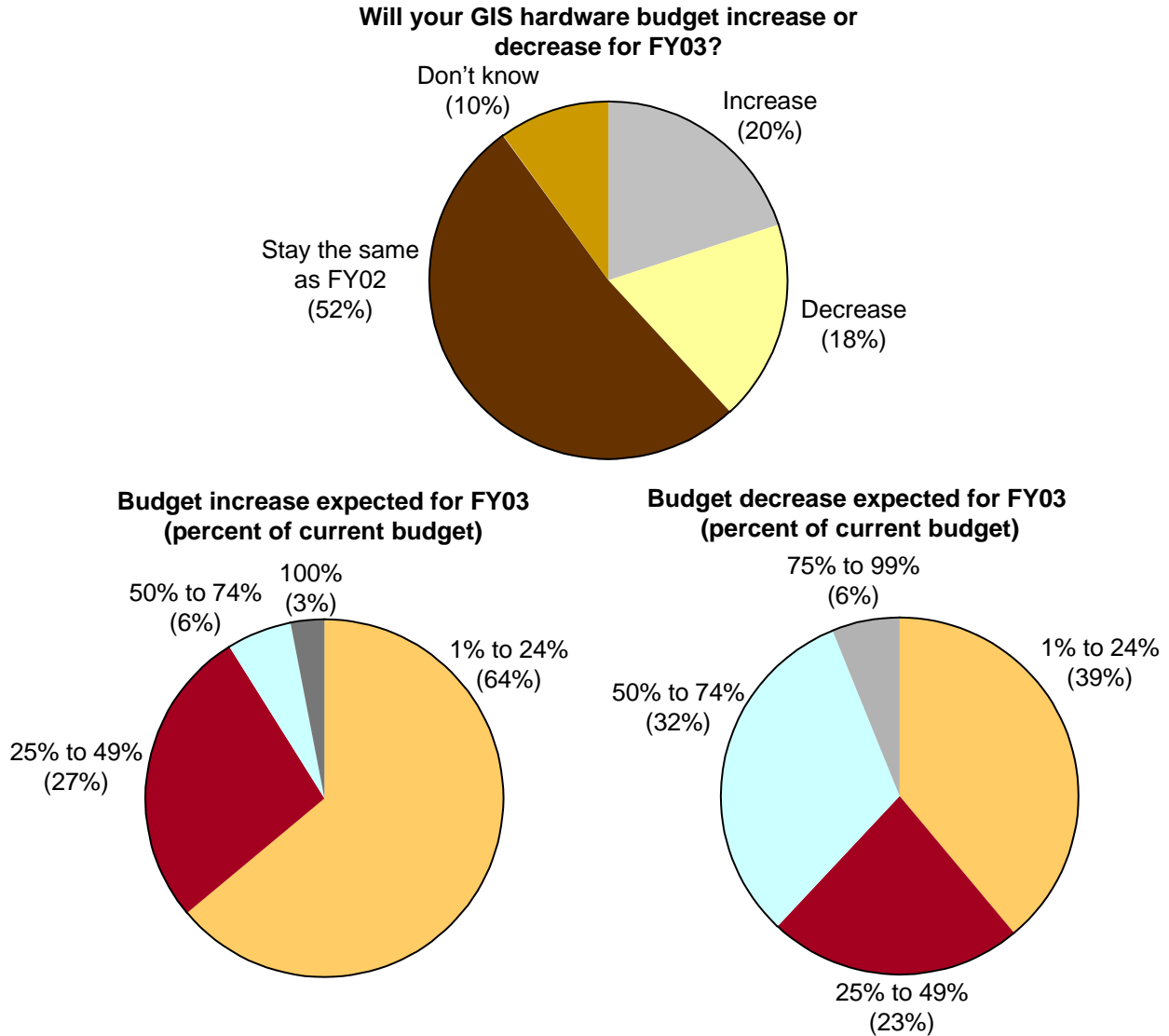
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Source: Gartner Research

Figure 25. FY02 GIS Hardware Budget

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Source: Gartner Research

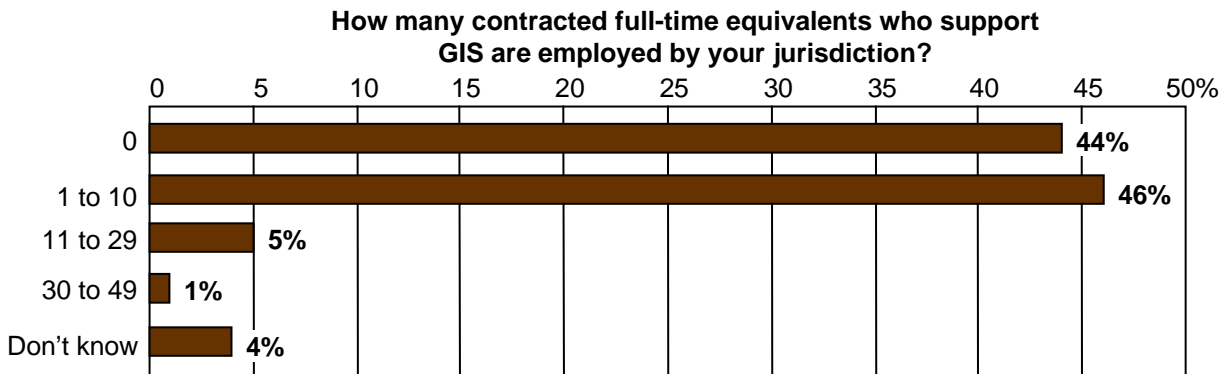
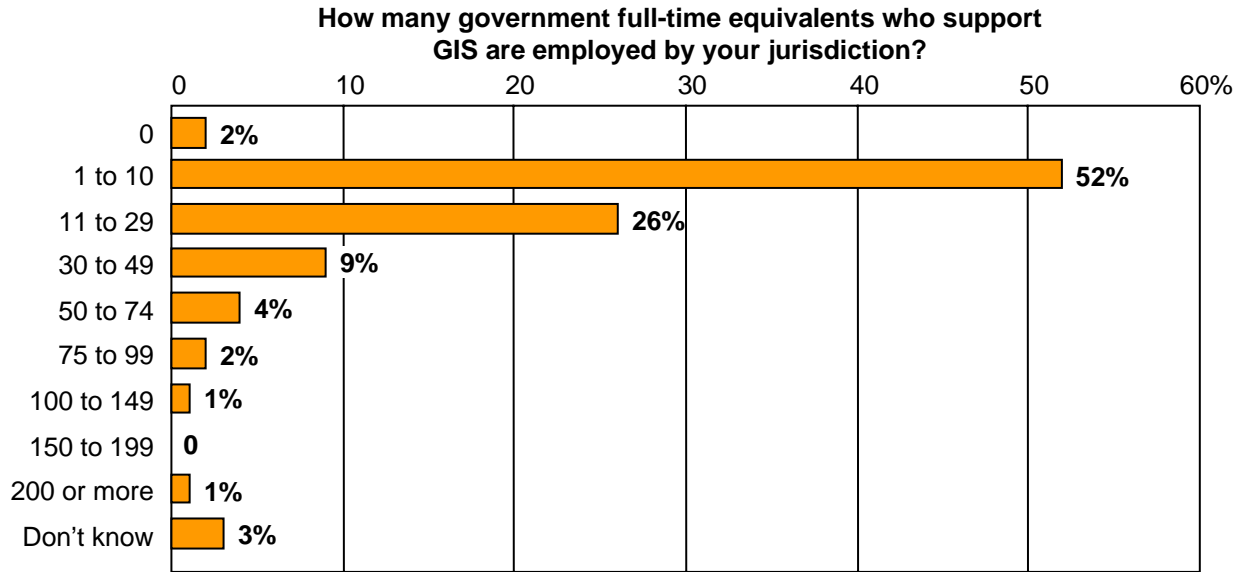
Figure 26. FY03 GIS Hardware Budget (Projected)

Overall, respondents do not expect to greatly increase their GIS hardware budgets in 2003.

6.3 Staffing

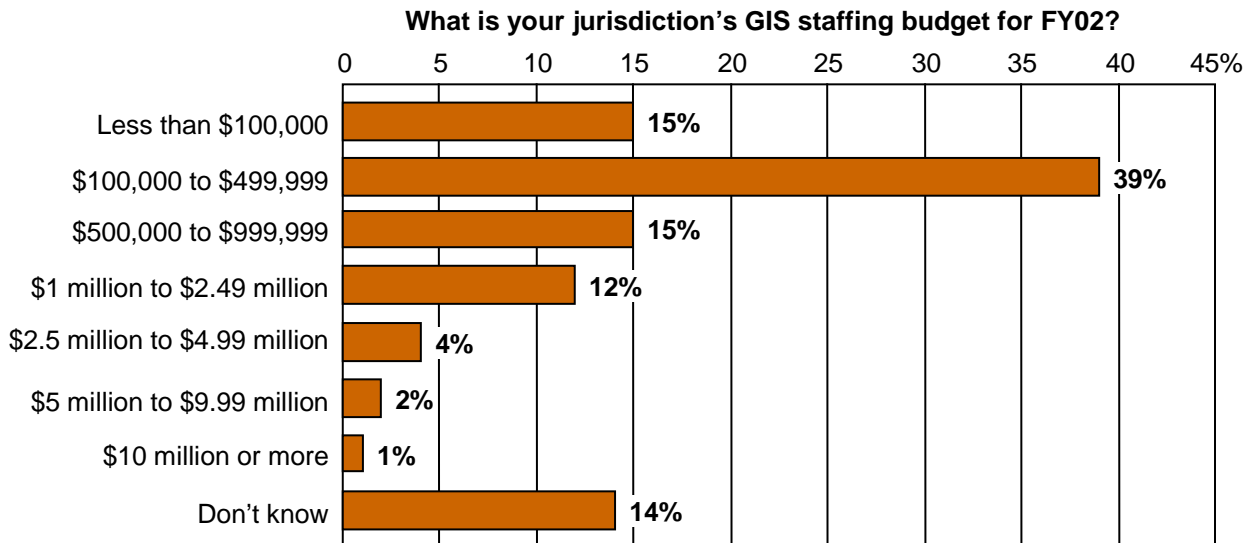
Respondents were asked about their FY02 and projected FY03 GIS staffing budgets (see Figure 27, Figure 28 and Figure 29).

U.S. Public-Sector GIS Survey: Key Issues and Trends



Source: Gartner Research

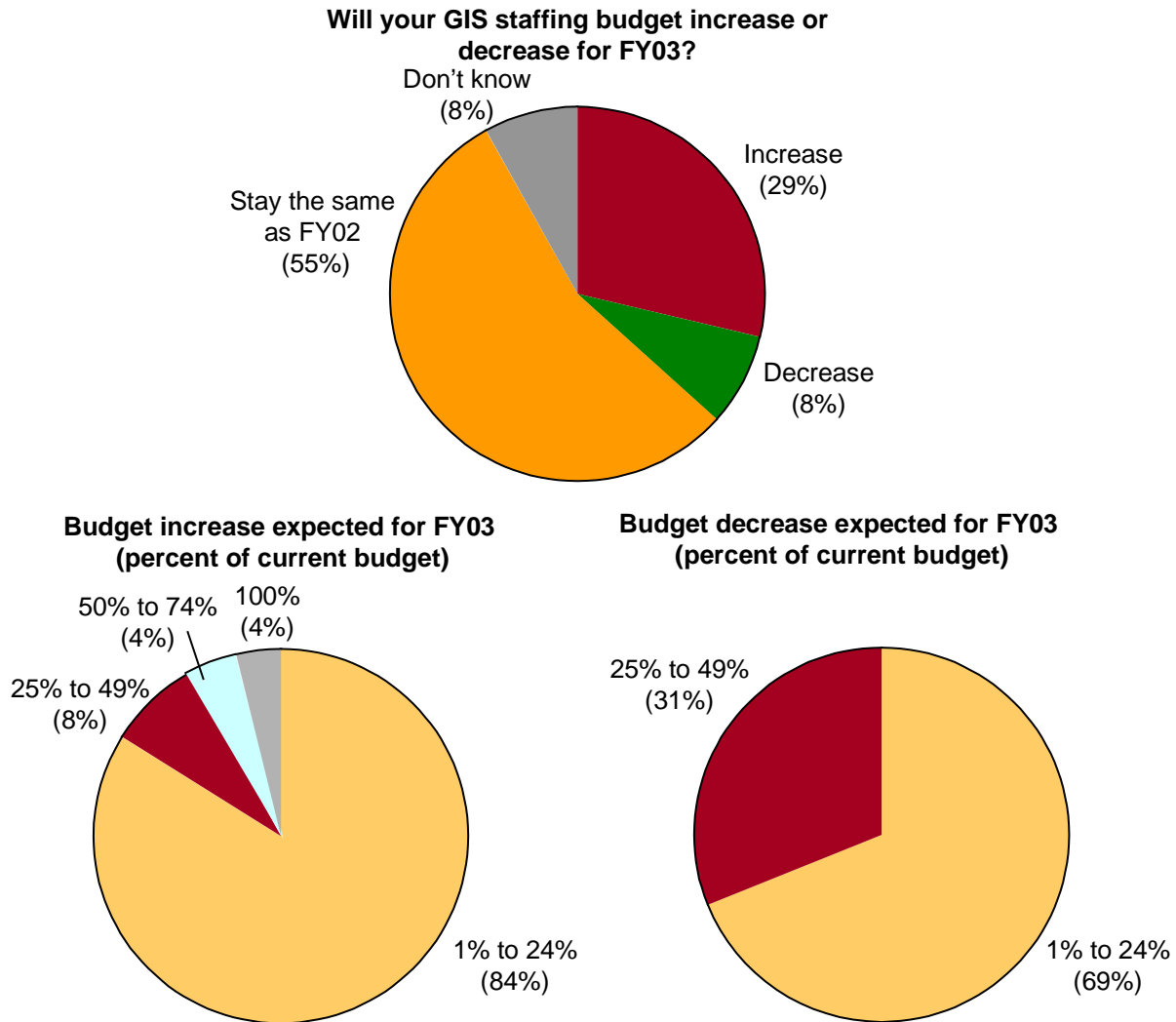
Figure 27. GIS Government and Contracted Full-Time Equivalents



Source: Gartner Research

Figure 28. FY02 GIS Staffing Budget

U.S. Public-Sector GIS Survey: Key Issues and Trends



Source: Gartner Research

Figure 29. FY03 GIS Staffing Budget (Projected)

Respondents also were asked to rate a list GIS staffing issues on the importance of resolving the issue (see Figure 30).

Issue	Percent Responding N/A*	Mean of 1-to-5 Responses**
Lack of technical expertise to develop a GIS	15%	3.2
Lack of technical expertise to develop an enterprisewide, multiuser GIS	17%	3.1
Lack of managerial expertise to manage an enterprisewide, multiuser GIS	18%	2.9
*Not applicable to respondent **Scale of 1 ("Not Important at All") to 5 ("Extremely Important")		

Source: Gartner Research

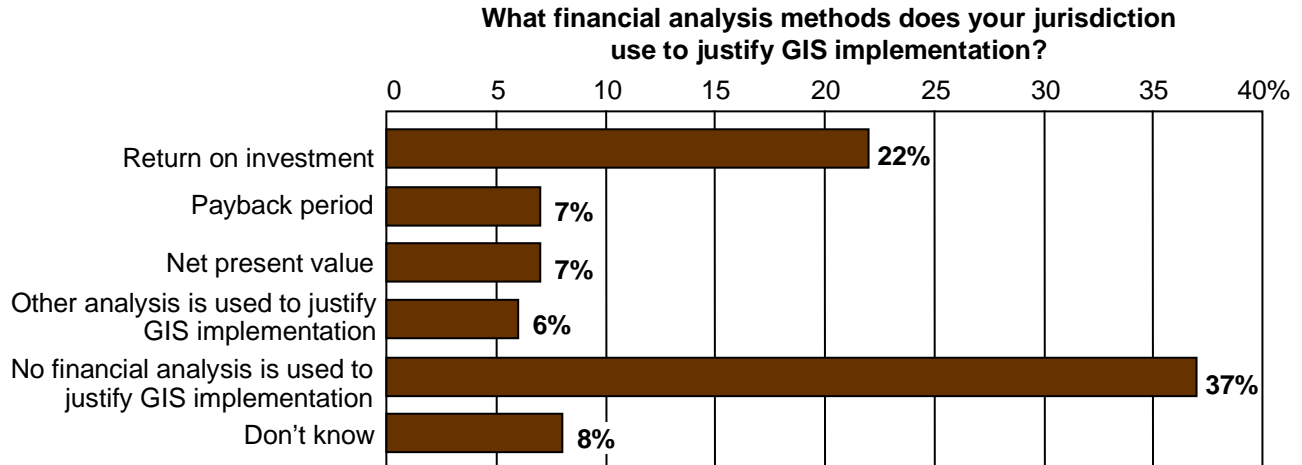
Figure 30. GIS Staffing Issues

U.S. Public-Sector GIS Survey: Key Issues and Trends

In 2003, we expect that there will be a slight upward trend in GIS staffing. Locating the appropriate skill levels will be moderately difficult.

6.4 Financial Analysis

Various financial analysis methods are used to justify GIS initiatives (see Figure 31).



Source: Gartner Research

Figure 31. GIS Financial Analysis Methods

Verbatim responses to "other analysis" indicate that a combination of constituent service and operational efficiency improvements help justify investments. There also were cases where GIS has become so ingrained in the business that in-depth financial analysis was viewed as not required.

6.5 Justifying GIS Operations

Respondents were asked to rate a list of GIS financial analysis issues on the importance of resolving the issue (see Figure 32).

Issue	Percent Responding N/A*	Mean of 1-to-5 Responses**
Ability to financially justify ongoing GIS operations to obtain funding	11%	3.5
Ability to financially justify new GIS initiatives to obtain funding	7%	3.8

*Not applicable to respondent
**Scale of 1 ("Not Important at All") to 5 ("Extremely Important")

Source: Gartner Research

Figure 32. GIS Financial Justification

Despite the success of some organizations in making the need for a GIS appear almost self-evident, the ability to obtain and maintain funding for GISs was an issue. Financial analysis is a good tool to demonstrate cost savings and operational efficiency. Surveys can help determine constituency needs and be applied to geospatial data management. Alignment with key organizational or political objectives is also important. See "The Gartner Framework for E-Government Strategy Assessment" (R-15-7573) for metric and tool categories to help justify GIS operations and initiatives.

U.S. Public-Sector GIS Survey: Key Issues and Trends

7.0 Summary and Recommendations

Several organizations are overcoming the historical lack of enterprise view for geospatial systems management. However, much work remains. An enterprise GIS approach will mitigate the set of issues identified by survey respondents. Therefore, governments and their subdivisions should consider these action items and issues:

- Establish strong governance structures for enterprise GIS. These will be instrumental in overcoming data standard, accuracy and quality issues, which hinder integration.
- Consolidate GIS network, platform and base-map infrastructures.
- Enterprise approaches to purchasing GIS products are one tool in overcoming the lock-in and support issues identified in this survey.
- Constituents' privacy concerns remain high. Improved constituent service via the Internet does not have to mean that personal information must be made immediately available for anonymous access. Privacy and freedom of information laws should be evaluated, and conflicts that create loopholes should be resolved.
- A tough economy will bring continued scrutiny on IT budgets, including GISs. Use financial analysis, constituency service improvements and alignment with enterprise goals as tools to justify ongoing GIS investment. Charging for value-added functionality and data is one way to offset costs for increased service delivery.

In future research, Gartner will offer analysis and recommendations regarding government geospatial technology and GIS management issues.

U.S. Public-Sector GIS Survey: Key Issues and Trends

Appendix A: Acronym Key

CAD	Computer-aided design
ESRI	Environmental Systems Research Inc.
GIS	Geographic information system
N/A	Not applicable
OCG	Open GIS Consortium