The Value Proposition for Geospatial One-Stop

A Report Prepared by Urban Logic, Inc., under Contract 0403CT70298 with the Federal Geographic Data Committee.

Date: as of May 19, 2004

1330 Avenue of the Americas • Suite 2200
Phone (212) 399-9700 • Fax (212) 582-8080
Email: bcahan@urbanlogic.org

Intended Use for this Report and Other Matters

This Report is intended to provide perspectives on valuing the federal Geo-Spatial One Stop initiative. It is by its nature a dynamic document, yet to be reviewed, approved, accepted or published. As principal author, I, Bruce Cahan, apologize in advance for errors of omission, attribution or otherwise, and undertake to correct them in future drafts as soon as they are brought to my attention.

This Report is intended to serve the limited function of engaging the collaborative knowledge and insights of a group of informal participants in this research. It will evolve and be revised as discussion of its methodologies proceeds and as further research is completed. Any other use of this Report and its contents in any form is expressly prohibited.

No copyright or other intellectual property interest is claimed by the author in any brand name, copyrighted work, registered mark, service mark, trademark or trade style referenced herein which are owned by or licensed to any third party, each of which shall be and remain the property of the respective lawful owner or licensee thereof. Such references are solely for the educational and research purpose of improving the reader's understanding of the concepts described herein, and in no way express or imply the review or approval by such owners or licensees of this Report or any part thereof.

Subject to the aforesaid acknowledgement of third-party copyright and other intellectual property rights, the statements, findings, conclusions and recommendations are those of the author, and do not necessarily reflect the policy or views of any Agency or official of the Federal government.

All items in this Report of a financial or legal nature are not intended to be specific or general advice in connection with any actual or potential dispute, problem, question, situation or strategy. Urban Logic, Inc. hereby notifies anyone reading this Report who seeks finance or legal information to consider obtaining independent professional financial or legal advice, as the case may be, that addresses the specific situation the person or the organization is encountering. Urban Logic, Inc. disclaims any liability for such misuse of this Report, and is not and does not make any representation or warranty as to the accuracy, up-to-date status, validity or applicability of financial or legal references or information referenced or contained in this Report. Any reader that relies on this information without consulting independent professional financial or legal counsel, as the case may be, does so solely at his, her or its own risk.

Table of Contents

Figures, Tables & Diagrams

Executive Summary

Geospatial One-Stop (**GOS**) is one of 24 e-government initiatives of President Bush, within the cluster aimed at improving government-to-government (**G2G**) operations. The explicit budget for GOS is $35 million over 7 years, roughly $5 million averaged annually. GOS leverages investments that federal agencies make in spatial data standardization, cataloguing and accessibility. Such spatial data is often a product or by-product of federal operations under a diverse cascade of statutory and executive requirements.

A two-step approach to valuing GOS requires *first*, knowing the value of spatially-enabling the federal enterprise (**spatial readiness**), and *second*, determining how much of a fully spatially-ready federal enterprise GOS accelerates. Thus, GOS' value depends on how much faster it causes agencies to perform as parts of a spatially-ready federal enterprise

The federal budget for FY '04 exceeded $2.4 trillion, of which $58 billion (2.4%) will be spent on information technology. Ideally, Step One would quantify how much federal agencies spend on *spatial readiness* – the institutional capacity to solve government-to-government issues using *spatial intelligence* (an understanding of where people, capital and institutions combine). In 1973, OMB's Federal Mapping Task Force compiled an extensive report on federal mapping, charting, geodesy and surveying activities, needs and expenditures. Despite generational changes in the applicable technology and federal organizational roles, no current survey of federal spatial readiness investments exists. Indeed, agencies fear cooperation in such surveys, citing budgets that were cut after survey participants provided details of their spatial readiness expenditures. Moreover, many of the organizational and budgetary concerns noted in 1973 have persisted, notwithstanding advances in technology and work process standardization and growing uses for spatial intelligence across the federal enterprise.

Absent reliable official figures on agency expenditures, the value of spatial readiness to the federal government (Step One) has been imputed using three different approaches:

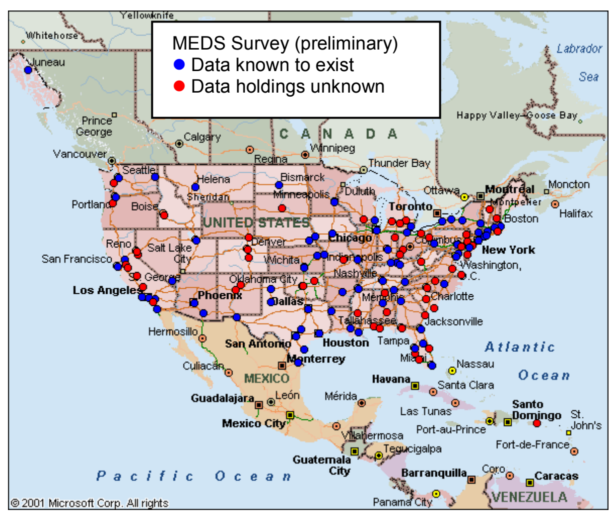
1. **Spatially-Intelligent Government Approach** - Imputing Spatial Readiness costs in proportion to Federal Enterprise Architecture's Business Reference Model (**BRM**)
2. **Legacy Costs Approach** - Extrapolating findings of the 1973 Federal Mapping Task Force
3. **Birthing of Applications Approach** - Adapting the USGS National Map Simulation Model

Each approach suggests the financial impact of the positive value of GOS due to:

1. **Improved Standards Development** - More open competition and input in developing national spatial data and technology standards, and completion of such standards faster, in time to use them in planned procurements
2. **Better Data Buys** - Improved coordination in spatial data acquisition and maintenance

3. **Better Discovery, Sharing & Use of Existing Data** - Facilitating online user discovery and customization of spatial data products
4. **More Accountable Investments** - Improved agency accountability for (and OMB acceptance of) spatial readiness investments
5. **Better Investment Options** - More transparent real-time knowledge of multiple investments in spatial data permit redundancies to turn into funding pools for buying spatial readiness across the federal enterprise
6. **Budgeting for Spatial Readiness Partnerships** - Greater emphasis on federal spatial readiness matched-funding programs that leverage ongoing state and local government data investments through statewide, regional and/or local partnerships

Each agency's spatial intelligence and investments in spatial readiness can be interdependent on and with those of other federal, state and regional players. Reducing the budget of programs essential to spatial readiness (or over-investing in the budgets of non-essential programs) dramatically affects the spatial readiness of the federal enterprise across and between BRM sub-functions. Optimal levels of spatial readiness investments can be difficult to visualize and alternative portfolio investment options difficult to conceive, absent a portal such as GOS' where data holdings and planned expenditures can be compared for a given geography, theme and scale. Thus, if fully implemented by the agencies, GOS promotes more rational budgeting for federal spatial readiness.



Gaps in spatial readiness affect intergovernmental operations every day. For example, the needs of the Department of Homeland Security and other federal agencies for spatial intelligence prior to and after an incident are particularly acute. Preliminary partial survey results[1] for 134 major urbanized areas call into question if there is any data (the red dots ●) and how much (the blue dots ●) of the minimum essential data sets (**MEDS**) required by federal participants in homeland security and emergency response operations (1) exists or (2) is known to exist. This finding underscores the immediacy of:

- improving discovery of spatial data holdings,
- standardizing those holdings for use and
- aligning the financing, acquisition and maintenance of key spatial data at the most local level so that it can be shared intergovernmentally.

[1] See discussion on page 26.

Assuming full implementation and acceptance, GOS appears a strong step in addressing such concerns.

Chapter 1 **Introduction**

Spatial intelligence is understanding *where* people, capital and institutions combine. **Spatial readiness** is the degree to which a problem that requires spatial intelligence can be solved based on information available as the problem arises.

The spatial intelligence of government determines the effectiveness of government operations. For instance, governments use the location benefits of regional and neighborhood free market activities to model[2] development and transportation incentives that exacerbate, ignore or contain urban sprawl. If economic development funds are deployed before the agency is spatially ready to do so, then the funds are spent without sufficient spatial intelligence to optimize the results for the affected people, capital or institutions.

Like other infrastructure, spatial readiness is achieved through a series of ongoing investments (**spatial readiness investments**) in hardware, software, data and institutional cultures to leverage, exchange and use spatial intelligence. GIS – geographic information systems – is industry shorthand for the infrastructure that provides spatial readiness. As a recent Gartner Group report concluded:

> GIS payback periods are often longer than those of other information systems. Visible, measurable financial benefits often are realized only at individual organization subdivision levels. Use [of] before-and-after measurements of financial gain, and constituent service and political return attributes [will] justify the value of GIS. Set expectations; focus on data integration and quality upfront. In addition to detailing financial and service benefits, demonstrate direct alignment with political goals.[3]

Contrast these observations with those of Mark Forman,[4] OMB's former Associate Director For Electronic Government and Information Technology, that while geospatial information has become the backbone of federal, state and local governments:

- 50% of the amounts spent on the technology is wasted,
- those investments generate redundant information that cannot be integrated for team purposes like homeland security, and
- meaningful missing federal standards would answer the call of states and local governments for improved data building coordination and investment.

What is the marginal value of improving the spatial intelligence of how governments operate? Would putting GOS in place increase this value?

---

[2] Generally, M. Fujita, P. Krugman & A. Venables, *The Spatial Economy: Cities, Regions and International Trade* (MIT Press 1999).

[3] G. Kreizman, *Research Note: The Value of GIS in Government Use the Gartner Framework for E-Government Strategy Assessment to demonstrate the benefits of implementing a geographic information system* (COM-16-5470
May 20, 2002).

[4] Alorie Gilbert, *News.Com Vision Series Profile: OMB's Mark Forman* (2002), pp. 5-6, http://news.com.com/pdf/ne/vs2/forman.pdf.

Such questions suggest a two-step valuation process:

Step One: The value of spatially-enabling government functions

Step Two: The value GOS brings to optimizing Step One

Chapter 2 **Description of GeoSpatial One-Stop Modules**

As described in its OMB Exhibit 300 and website[5], GOS has 5 major components:

1. **Complete National Spatial Data Standards** - Complete the development of open, functional intergovernmental standards and models for geospatial framework data content;
2. **Inventory & Index of Federal Agency Spatial Data Holdings** - Provide an interactive index to existing geospatial data holdings at the Federal and non-Federal levels;
3. **Partnering** - Promote partnership among Federal, state, and local agencies for sustainably investing in future geospatial data collections;
4. **Data Accessibility** - Provide an online access to geospatial data through the Geospatial One-Stop's Portal; and
5. **Federal Spatial Investment Strategy** - Commit the federal government to consistent investment criteria for an ongoing enterprise pattern of sustainable co-investments in geospatial datasets that facilitate and scale the levels of similar investment activity observed and to be leveraged in state, local, tribal and private sectors

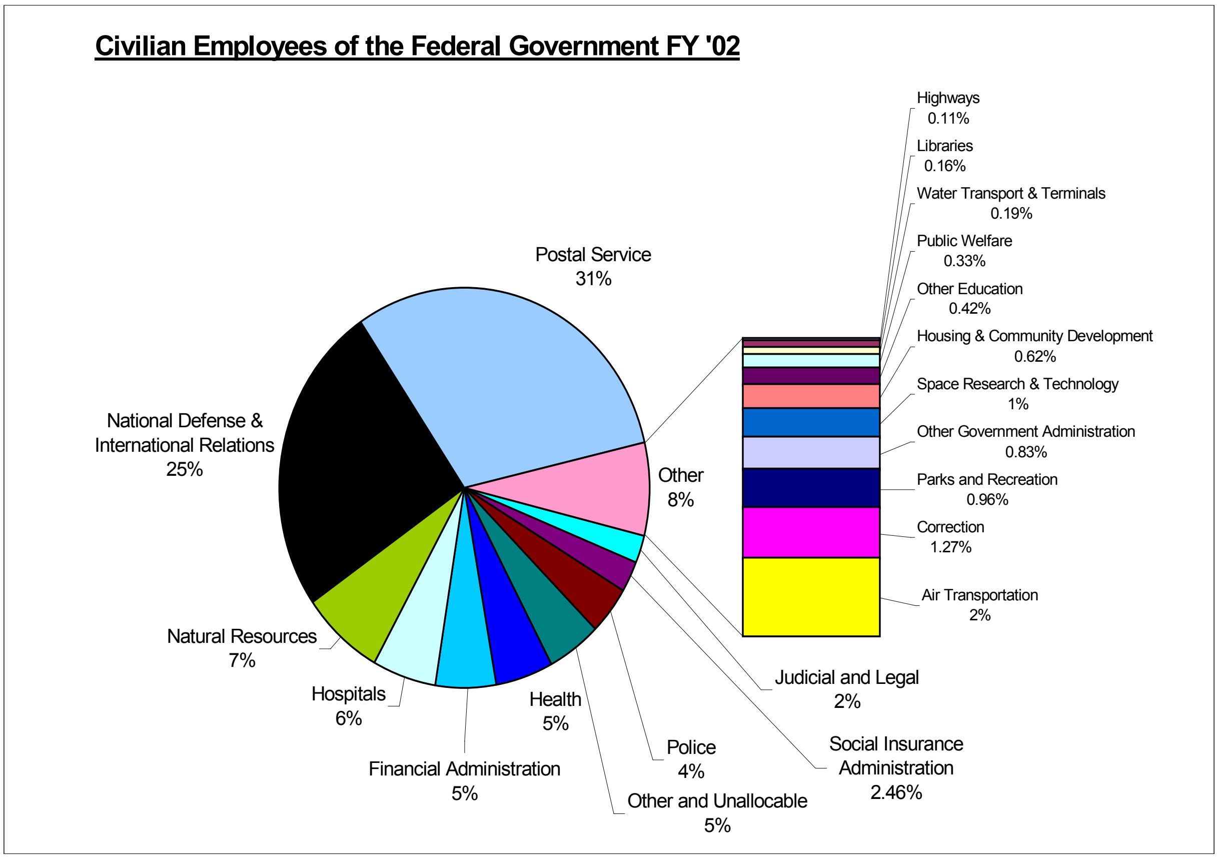
[5] See generally, GeoSpatial One-Stop, www.geo-one-stop.gov, and its portal, www.geodata.gov.

Chapter 3 **Step One: The Value of Spatially-Enabling Federal Government**

OMB's Federal Enterprise Architecture (**FEA**) and accompanying business reference model (**BRM**)[6] suggest the business activities of the federal government to (1) citizens, (2) businesses, (3) other governments (state, local, tribal and intergovernmental), and (4) interagency.

The federal government in FY '04 spent a budget of $2.1 trillion, had an FY '02 civilian workforce of approximately 2,426,000 full-time employees (**FTE**s) and 263,000 part-time employees (**PTE**s) working billions of man-years organized in 14 Departments and 91 independent agencies and government corporations,[7] managing hundreds of programs authorized by Congress as described in 50 Titles of the Code of Federal Regulations.

Figure 1 Federal Employees by Agency (FY '02)



Source: Census, *Federal Employment by Function*, http://www.census.gov/govs/apes/02fedfun.txt.

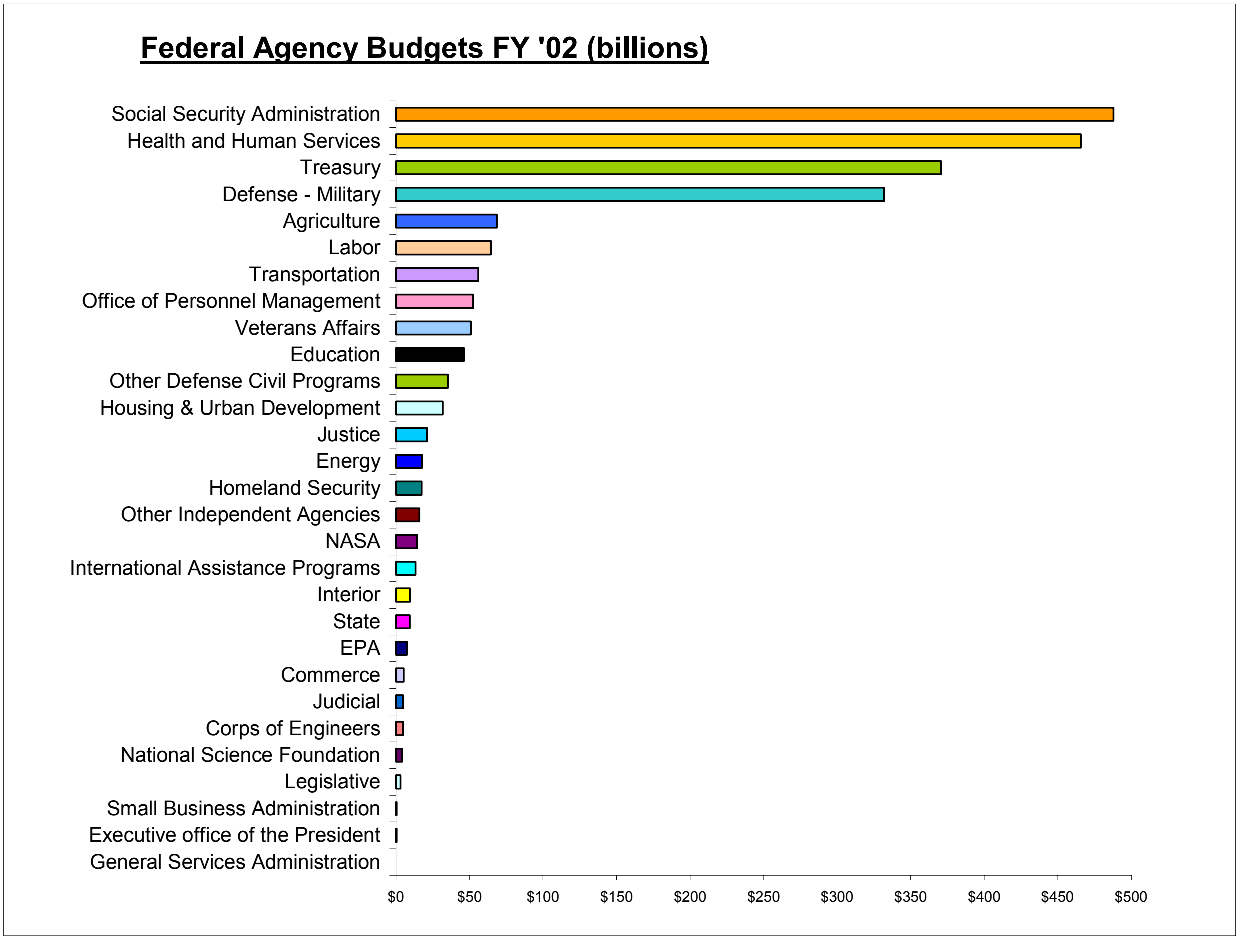
---

[6] The Business Reference Model is part of the ongoing work of the Federal Enterprise Architecture Program Management Office, http://www.feapmo.gov, where current documentation on the BRM and related Performance, Service and Technical Reference Models can be found, http://www.feapmo.gov/resources/fea_document_map_rev_1.pdf.

[7] U.S. Senate Committee on Government Affairs, *U.S. Government Policy & Supporting Positions (The Plum Book)*, (November 8, 2000), http://www.opm.gov/PlumBook/intro.pdf, pp. vii and viii.

In FY ’02, Federal officials outsourced $271 billion in procurements to the private sector through thousands of contracts and other arrangements, and another $412 billion through grants.[8] They transferred and monitored $362 billion[9] in federal funds to the 50 states and 87,849 units[10] of local government for a national variety of programs.[11] The most numerous of local government recipients were either school districts (13,522 – 15%) or special districts for fire, natural resources, community development, water and sewer services or a mixture (38,356 – 40%).[12]

Figure 2 Federal Agency Budgets FY ‘02



---

[8] Census Bureau, *Consolidated Federal Funds Report: Fiscal Year 2002 Detailed Federal Expenditure Data - United States*, http://harvester.census.gov/cffr/asp/Geography.asp.

[9] Census Bureau, *Federal Aid to the States for FY ’02* (May 2003), Table 1, p. 1, http://www.census.gov/prod/2003pubs/fas02.pdf.

[10] Census Bureau, *2002 Census of Governments*, http://www.census.gov/govs/cog/2002COGprelim_report.pdf, p. 1.

[11] See Appendix A listing the programs by agency in Census Bureau, *Federal Aid to the States for FY ’02* (May 2003), http://www.census.gov/prod/2003pubs/fas02.pdf.

[12] Census Bureau, *2002 Census of Governments*, http://www.census.gov/govs/cog/2002COGprelim_report.pdf, pp. 8 and 10.

Coordinating federal programs internally and with intergovernmental partners is daunting in scale, geographic diversity and immediacy of need. Finding, addressing, investing in and monitoring responses to community are key to management effectiveness and enterprise productivity. Spatial intelligence is a strong tool for coordination.

GOS is one of many information technology (**IT**) projects. Roughly 5% of federal agency budgets are spent on IT leaving 95% spent on buildings, personnel, grants and other activities, services and assets. This 5%: 95% relationship suggests that GOS' value includes a portion of two kinds of efficiencies:

- Savings in IT funds (i.e., conserving the fraction of 5% of agency IT budgets spent on spatial readiness)
- Savings & Innovation in using Non-IT funds (i.e., the payback of agencies using spatial intelligence to manage the bulk of their budgets – 95%)

The Business Reference Model can be used to visualize spending patterns in agency IT and non-IT budgets, as shown in Figure 3.[13]

Figure 3 FY '04 Agency Budget Requests Portrayed as FEA BRM Sub-functions

		IT Budgets Allocable to Sub-function	Non-IT Budget Allocable to Sub-function
Community and Social Services	Homeownership Promotion	$537.52	$43,825.32
	Community and Regional Development	$455.63	$27,848.12
	Social Services	$746.06	$56,961.26
	Postal Services	$0.00	$0.00
Correctional Activities	Criminal Incarceration	$115.37	$1,375.18
	Criminal Rehabilitation	$96.24	$1,158.76
Defense and National Security	Strategic National and Theater Defense	$6,975.06	$100,724.95
	Operational Defense	$6,975.06	$100,724.95
	Tactical Defense	$6,975.06	$100,724.95
Disaster Management	Disaster Monitoring and Prediction	$631.24	$7,603.17
	Disaster Preparedness and Planning	$1,132.38	$42,936.77
	Disaster Repair and Restore	$662.94	$10,358.48
	Emergency Response	$1,127.23	$42,869.20
Economic Development	Business and Industry Development	$803.67	$33,399.11
	Intellectual Property Protection	$290.70	$21,268.58
	Financial Sector Oversight	$226.16	$22,865.14

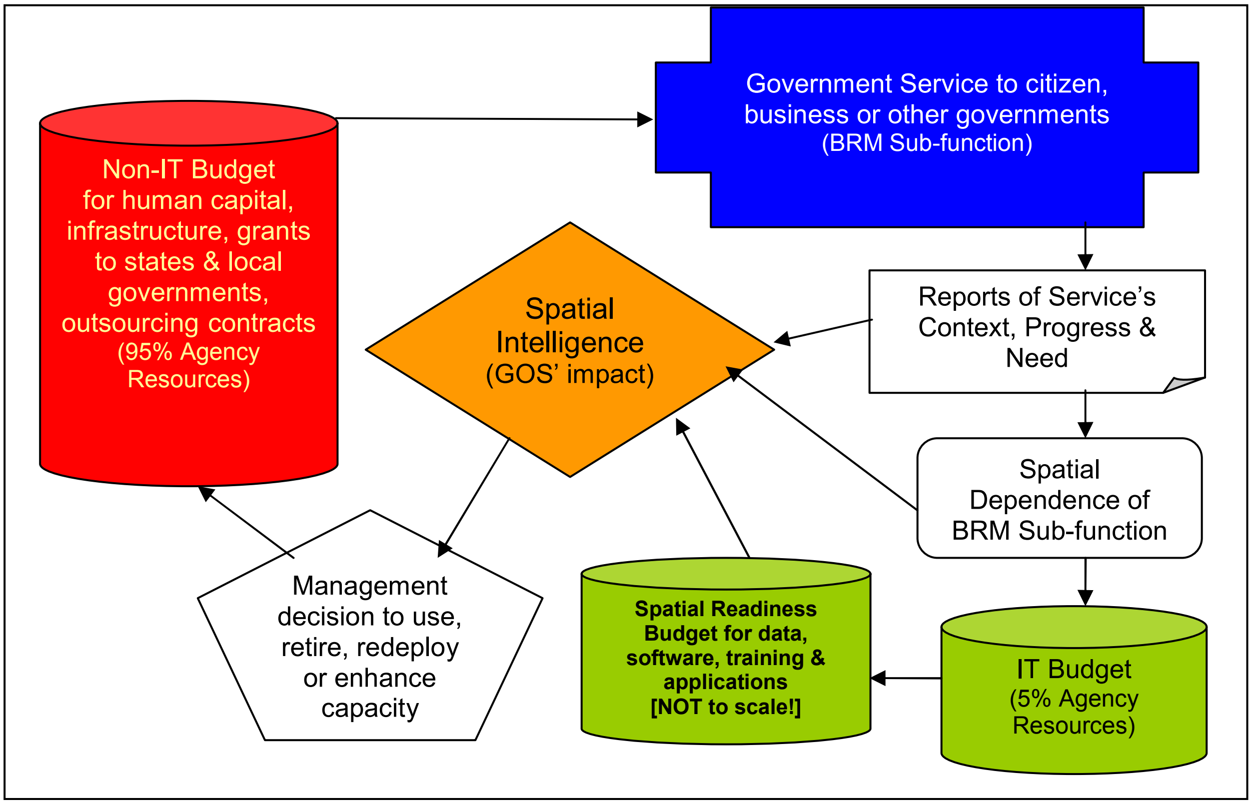
[13] Figure 3 uses an averaging method to assign overall IT and non-IT budgets to BRM sub-functions. If an agency performs 3 sub-functions, its IT and non-IT budget request was divided in thirds and assigned to each sub-function. The aggregate budget requests assigned to each sub-function were then totaled to portray the IT and non-IT budgets allocable to it. Currently, Urban Logic is attempting to refine this averaging methodology using the GSA Federal Procurement data for FY '00 - FY '03 to assign actual hard dollar procurement figures to the IT-budget for each BRM sub-function

		IT Budgets Allocable to Sub-function	Non-IT Budget Allocable to Sub-function
	Industry Sector Income Stabilization	$83.33	$2,805.56
Education	Elem., Sec., and Voc. Education	$249.81	$15,689.07
	Higher Education	$7,224.87	$116,414.02
	Cultural and Historic Preservation	$110.57	$8,782.13
	Cultural and Historic Exhibition	$49.58	$185.97
Energy	Energy Supply	$295.44	$4,459.77
	Energy Conservation and Preparedness	$212.11	$1,654.21
	Energy Resource Management	$437.85	$3,696.89
	Energy Production	$192.98	$1,437.79
Environmental Management	Environmental Monitoring and Forecasting	$772.26	$15,450.67
	Environmental Remediation	$202.30	$5,004.60
	Pollution Prevention and Control	$334.20	$11,038.53
General Science and Innovation	Scient. and Tech. Res. & Innovation	$474.97	$4,380.79
	Space Exploration and Innovation	$269.56	$1,655.44
Health	Illness Prevention	$473.43	$41,000.52
	Immunization Management	$418.00	$38,106.10
	Public Health Monitoring	$571.89	$38,981.07
	Health Care Services	$408.50	$38,115.60
	Consumer Health and Safety	$912.16	$60,043.52
Homeland Security	Border and Transportation Security	$922.73	$87,650.60
	Key Asset and Critical Infrastructure	$277.81	$1,786.47
	Catastrophic Defense	$277.81	$1,786.47
Income Security	General Retirement and Disability	$200.03	$63,192.83
	Unemployment Compensation	$113.67	$59,121.89
	Housing Assistance	$234.51	$9,997.08
	Food and Nutrition Assistance	$102.47	$3,021.98
	Survivor Compensation	$278.13	$88,560.18
Intelligence Operations	Intelligence Operations (TBD)	$0.00	$0.00
International Affairs and Commerce	Foreign Affairs	$773.92	$90,355.65
	International Development and Humanitarian Aid	$409.82	$29,794.74
	Global Trade	$309.95	$23,279.03
Law Enforcement	Criminal Apprehension	$990.42	$58,764.89
	Criminal Investigation and Surveillance	$1,075.04	$59,746.20
	Citizen Protection	$383.45	$3,171.40
	Crime Prevention	$383.45	$3,171.40
	Leadership Protection	$973.29	$59,304.51
	Property Protection	$748.39	$33,532.81
	Substance Control	$402.21	$23,680.06

		IT Budgets Allocable to Sub-function	Non-IT Budget Allocable to Sub-function
Litigation and Judicial Activities	Judicial Hearings	$774.94	$108,658.84
	Legal Defense	$115.37	$1,375.18
	Legal Investigation	$832.28	$100,217.03
	Legal Prosecution and Litigation	$931.72	$100,938.73
	Resolution Facilitation	$328.73	$7,407.13
Natural Resources	Water Resource Management	$36.63	$522.00
	Conserv., Marine, and Land Mgmt.	$396.76	$25,114.42
	Recreational Resource Management and Tourism	$427.21	$25,083.98
	Agricultural Innovation and Services	$83.33	$2,805.56
Transportation	Ground Transportation	$203.22	$2,335.16
	Water Transportation	$369.54	$3,689.68
	Air Transportation	$82.33	$1,677.04
	Space Operations	$82.33	$1,677.04
Workforce Management	Training and Employment	$1,524.88	$142,280.84
	Labor Rights Management	$1,098.70	$49,340.21
	Worker Safety	$184.04	$8,084.98
***Revenue Collection**	Debt Collection	$279.30	$24,015.01
	User Fee Collection	$401.91	$25,182.00
	Federal Asset Sales	$452.04	$27,024.26

The following chart suggests the processes of spatial readiness investments that GOS may influence:

Figure 4 Processes that Create Spatial Readiness Investments



All functions of government are not equally spatially dependent. Payroll and processing tax returns are not as dependent on spatial readiness as emergency response, environmental conservation or public health. Thus, investments in spatial readiness – such as GOS – can be expected to have larger impacts and ROIs for government operations that depend more on spatial intelligence, as the following matrix suggests:

Figure 5 How Spatial Readiness Impacts BRM Sub-Functions

Spatial Readiness Impact Matrix	BRM Sub-functions that are Spatially-Dependent	BRM Sub-functions that are not Spatially Dependent
Agency's IT Budget (average 5%)	Very large impact	Medium-small impact
Agency's Non-IT Budget (average 95%)	Medium-large impact	Low impact

One could conceive of beginning the federal fiscal year (October 1st) with a meter of either FTE and PTE hours worked, overhead incurred or dollars paid to other entities (other governments, contractors, intergovernmental partners, etc.) These hours and dollars are expended in accordance with the BRM thematically (for specific environmental, tax enforcement or other reasons), seasonally (IRS' tax season or USDA's planting season) and geographically (we conserve coastline in Maine, not Utah).

Across these hours and dollars are many management and routine operational decisions. There are also decisions relating to the design, maintenance, use, disposition or sale of capital equipment, buildings and land, whereby capital asset conditions, locations and commitments impact future operating budgets.

Every decision has these elements:

- The value of making no decision = the value of assuring the status quo = Risk x Reward of doing nothing
- Marginal Utility of making the decision correctly = (Risk x Reward of Decision) – (Risk x Reward of Status Quo)
- The Risk is a function of the uncertainty of:
    - Knowing all the questions to ask & answer before making the decision
    - These questions are a function of authority, scope, scale, time and geography
        - Authority: legal authority to make the decision regarding a scope of activity
        - Scope: domain of problem space
        - Scale: how problem in its space relates to macro and micro factors
        - Time: seasonality of when the decision would go into effect vs the data on which the decision is being based
        - Geography: the place and attributes of the place where the decision would go into effect
- The Reward is the sum of:
    - Intrinsic Reward would be a function of the efficiency & effectiveness in internal federal operations if the decision is made correctly
    - Extrinsic Reward is what third parties would pay the federal government (or reduce their requirements for the federal government to pay) if the decision is made correctly
    - Social Reward is what society as a whole receives as public goods from the decision (i.e., safety, economic development, environmental, etc.)

Without spatial intelligence, the five Risk Factors are unconnected in place at a given time, and the benefit streams of the Reward are not traceable to the successful decision.

$$ValueofNonspatialDecisionmaking \approx$$

$$\sum_{1}^{\infty} FederalEnterprise \begin{bmatrix} RiskofEachDecision \int(Authority, Scope, Scale, Time, Geography) \\ x\,\mathrm{Re}\,wardBenefitsofEachDecision \int(Intrinsic, Extrinsic, Social) \end{bmatrix}$$

Spatial intelligence lets the decision maker pull together all data describing authority, scope and scale as relating to a particular place at a particular time. Thus, the benefits of spatial intelligence for the decision maker and the federal enterprise can be written as follows:

$$ValueofSpatialDecisionmaking \approx$$

$$\sum_{1}^{\infty} FederalEnterprise \begin{bmatrix} RiskofEachDecision_S \int (Authority_S, Scope_S, Scale_S, Time_S, Geography_S) \\ x\,\mathrm{Re}\,wardBenefitsofEachDecision_S \int (Intrinsic_S, Extrinsic_S, Social_S) \end{bmatrix},$$

where the variables subscripted with *s* are the spatially-aware versions of the variables used above.

This spatially-enabled set of variables for decisions do not appear out of thin air. Investments in training, equipment and data are required. Organizational investments in exchanging data and networks and web options to improve exchange. Thus, the transition from non-spatial decision making to spatial involves a set of investments for most enterprises, including the federal government, that logically ought (1) to be amortized over their useful life and (2) to be supported by annual operating funding of salary, data refreshment and other expenses that optimize and extend the useful life of the capital investment that created the spatial decision support capital asset. The net value of spatially-aware decision making would need to reflect (1) these investments as amortized through annual costs and (2) their accompanying annual lifecycle-extending ongoing expense:

$$CostofSpatialDecisionmaking \approx$$

$$\sum_{1}^{\infty} FederalEnterprise \begin{bmatrix} AnnualizedCapitalInvestment_S \\ \int \begin{pmatrix} EstablishingSpatialDMSupport \\ \int (Hardware, Software, DataIntegration, LegacyConversion) \end{pmatrix} \\ xAnnualOptimumOperatingCosts_s \int (FTE, PTE, data \,\&\, other \cos tstooextendlifecycle) \end{bmatrix}$$

Summarizing, the net of value less the cost of spatially enabling the federal enterprise looks like this:

$$NetValueofSpatialDecisionmaking \approx$$

$$\sum_{1}^{\infty} FederalEnterprise[(ValueofSpatialDecisionmaking) - (CostofSpatialDecisonmaking)]$$

These net value calculations are being made by each agency and program at multiple levels, so that the effective rate of becoming spatially-enabled varies by a number of factors:

- Cost of & Resistance to Migrating from Existing Investments in spatial decision support systems
- Perceived Budgetary Climate for New & Ongoing Investments
- Availability & Desirability of Partnered Investments with Other Agencies

In essence, these factors permit deriving a capital formation function describing the actual rate of how much capital will flow into spatially-enabling investments, as follows:

$$ActualRateofSpatialCapitalInvestments \approx$$

$$\sum_{1}^{\infty} FederalEnterprise \int^{(CostofSpatialDecisionmaking)} x(1 + LikelihoodOngoingInvestments)$$
$$x(1 + LikelihoodofNewInvestments)$$

This suggests that the actual rate may be less or more than the optimized rate of spatial investments for a given agency or function within an agency.

$$OptimizedRateofSpatialCapitalInvestments \approx ForeachBRMbu\sin essline$$

$$\sum_{1}^{\infty} FederalEnterprise \int^{(CostofSpatialDecisionmaking_{optim})} x(1 + LikelihoodOngoingInvestments_{optim})$$
$$x(1 + LikelihoodofNewInvestments_{optim})$$

Chapter 4 **Step Two: The Value of GOS**

Once the difference between the actual and optimized rates of spatial investments is known for the federal enterprise at the level of agency business lines, then the marginal impact of GOS can be addressed.

For argument's sake, assume that there are two types of agencies:

- **Early Adopters** – those agencies whose business activities, culture and management, and Congressional appropriators urged to invest in spatial intelligence for over 5 years, and therefore have legacy data and systems, employee and regulatory practice culture and other community and vendor issues weighing as institutional constraints on optimizing their spatial investments

- **Late Adopters** – those agencies whose core missions are to a large extent still performed or up until 5 years ago were performed without spatial intelligence and decision support, and who have learning curves, Congressional appropriations, data and systems procurement, maintenance, employee training, and other regulatory, community and vendor issues to surmount in initiating and putting into daily operation critical geospatial support

Across the federal enterprise, Early Adopters and Late Adopters are not randomly distributed. Early Adopters cluster around certain lines of business where spatial intelligence in other forms (i.e., paper maps, drawings, street addresses, etc.) was pioneered and used for centuries before their digitized versions arrived. Late Adopters likewise cluster around lines of business where narrative reports, spreadsheet data or oral communications has been the norm for communicating and transacting that business. Early Adopter examples might be mapping state boundaries, rivers and coastlines, census or road construction. Late Adopter examples might be human resources administration, inventorying federal property holdings or law enforcement.

Spatially-enabling e-government entails addressing the prototypical constraints each type of Adopter faces in reaching its optimized level of spatial investment.

Optimizing spatial investments in each type of agency (or function within an agency) differs in a world before vs. after GOS. The following tables suggest these differences:

Figure 6 Early Adopters' Challenges in Spatially-Enabling Business Processes

	Before GOS	After GOS
Framework of Data	Focused on "Mission-critical" a/k/a stovepiped	Multi-purpose, multi-user approach
Metadata	Limited & not shared so reliability untested. Standards for metadata incomplete and in some cases inappropriate to business lines that could benefit from sharing data.	Requirement to register metadata holdings proves sharability of underlying data. Refocusing and completion of FGDC standards activities removes inertia and excuse for not "doing metadata."
Legacy Data & Systems	Limited budgetary argument for upgrading to generate enterprise benefits of using data	Capital plans registry for data acquisitions & conversions can be portrayed as generating enterprise-wide benefits

	Before GOS	After GOS
Employee Culture	Siege mentality. Separate management knowledge of what data is used for from budgetary process of paying for it	Brings data stewards up the organizational ladder to tell the benefits & challenges of what missions their data activities support
Vendor Culture	Divide the agencies and business activities within agencies into stove-piped camps where the rate of interoperability is market-constrained by the rate of annual versioning in software and hardware vendors choose to incorporate in their offerings	Sets the procurement options at the enterprise level making interoperability standards and product performance the norm. Capital plans registry attracts notice of vendors, thereby growing the market for interoperable products and services faster
Reengineering Regulatory Oversight & Paperwork for Citizen Transparent Accountability	Data holdings scattered, with only limited tools to find current spatial data being used by agencies to make and model their decisions Paper-based regulatory processes persist in digital version of old forms and resist streamlining	Portal exposes and widely disseminates the spatial data being used to make decisions, so citizens and other governments (state/local/tribal) can update, query and supplement data before federal decision is made without seeing or understanding all the facts. Regulatory burden can be rescoped and eased using reporting, inspections and analytic tools built to spatially-aware standards so that the unique facts known to reporting entities are requested, not "community census" of contextual elements.
Congress	While abhorring agency stovepipes, separate jurisdictions of Appropriations Committees guard fiefdoms to protect separateness of agency's historic spatial activities	Permits OMB as enterprise CIO to budget across the federal enterprise and explain to each Appropriations Committee the increase in efficiency and effectiveness of its agencies' spatial intelligence in delivering services

Figure 7 Late Adopters' Challenges to Spatially-Enabling Business Processes

	Before GOS	After GOS
Framework of Data	Focused on "Mission-critical" a/k/a stovepiped. Spatial elements in data underused as common denominator for analysis	Multi-purpose, multi-user approach to organizing data. "Friendly competition" amongst agencies fosters credibility for organizing data holdings to leverage spatial elements
Metadata	Limited metadata because no or very limited geospatial use	Requirement to register metadata holdings proves sharability of underlying data. Refocusing and completion of FGDC standards activities removes inertia and excuse for not "doing metadata."
Legacy Data & Systems	No prior budgetary support for spatial data or systems (or agency would have been an Early Adopter by now)	Capital plans registry for data acquisitions & conversions can be portrayed as generating enterprise-wide benefits

	Before GOS	After GOS
Employee Culture	Siege mentality. Separate management knowledge of what data is used for from budgetary process of paying for it	Brings data stewards up the organizational ladder to tell the benefits & challenges of what missions their data activities support. Spatial intelligence “champions” within agency emerge or are attracted to it
Vendor Culture	Limited audience for spatial adoption means little effort spent to try to sell products & services there	Sets the procurement options at the enterprise level making interoperability standards and product performance the norm. Capital plans registry attracts notice of vendors, thereby growing the market for interoperable products and services faster
Reengineering Regulatory Oversight & Paperwork for Citizen Transparent Accountability	Data holdings scattered, with only limited tools to find current spatial data being used by agencies to make and model their decisions	Portal exposes and widely disseminates the spatial data being used to make decisions, so citizens and other governments (state/local/tribal) can update, query and supplement data before federal decision is made without seeing or understanding all the facts
Congress	While abhorring agency stovepipes, separate jurisdictions of Appropriations Committees may have resisted authorizing ongoing spatial investments	Permits OMB as enterprise CIO to budget across the federal enterprise and explain to each Appropriations Committee the increase in efficiency and effectiveness of its agencies’ spatial intelligence in delivering services. Brings new Congressional “competitiveness” to bear, so Appropriations Committees disfavoring or ignoring spatial intelligence can be shown those Committees embracing it

Early and Late Adopters may have other differences than Tables 1 and 2 illustrate. Even so, the Tables show a qualitative difference and a marked similarity in how each agency type deals with the elements challenging how it optimizes spatial investments before and after GOS. Quantitatively measuring the impact of those differences and similarities on optimization could be approached as probability questions: *How likely is it (before GOS vs after GOS) that an agency – be it an Early or Late Adopter - would optimize its spatial investments?*

The probabilities of optimized result are an area of statistical conjecture without detailed study that is beyond the scope of this Report. However, the probabilistic formula initially can be expressed as follows:

$$\Pr obabilityofOptimizedSpatialInvestments = \frac{DataValueinUse}{OpportunityCostofCapital} \times \left(OptimizationConstra\,\mathrm{int}\,s_{AdopterType} \times GeneralKnowledgeofConstra\,\mathrm{int}\,s\,\mathrm{Im}\,pact_{AdopterType}\right)$$

If GOS addresses the “Optimization Constraints” that agencies face as Early and Late Adopters, then the probability that their spatial investments will become optimized over time is more certain with GOS than without for at least three pragmatic reasons:

First, the Constraints that agencies faced individually or in small groups are now being addressed across the federal government by specific GOS Modules on standards completion, metadata registries, portal development and data acquisition plans

Second, the institutional data culture that a particular agency's business processes has evolved to optimize spatial intelligence (under that agency's constraints) is now known and discoverable more widely: either that agency's data is or is not registered as metadata compliant or that agency has meager or robust spatial data holdings to register at all with GOS

Third, the impact of addressing those constraints timely as a management and budget priority (and accountability for doing so) is now more widely felt and its benefits and delays more easily described to and prioritized favorably by Department CIOs, the President's Management Council, OMB, GAO and Congress.

Chapter 5 **Quantifying the Value of Combining Steps One and Two**

The discussion of valuing spatial intelligence for the federal enterprise and what role GOS would play to optimize realizing that value sooner depends upon gathering significant data regarding the levels of current spatial investments across federal agencies.

While some of the numbers are known or their magnitude can be inferred, no one has an accurate catalogue of spatial readiness investments. At the June 10, 2003 House Subcommittee's hearing on GOS,[14]

- Scott Cameron (the managing partner of GOS and Deputy Assistant Secretary For Performance And Management at the Department Of The Interior) stated that "billions" of dollars are invested annually by the public sector (federal and non-federal)
- Mark Forman (OMB's former Administrator for the Office Of Electronic Government and Information Technology) said that "billions of dollars" of wasteful federal spending could be eliminated through GOS
- Jack Dangermond, President of ESRI (a leading software provider) said that the market for GIS tools (software, hardware and services) is a $5 billion business
- G. Michael Ritchie, President Management Association for Private Photogrammetric Surveyors (MAPPS) detailed the federal government's need to conduct a comprehensive inventory of and budget for geospatial programs, expenditures and uses
- Linda Koontz, GAO's Director of Information Management Issues, cited a 1993 OMB data call that found $4.1 billion spent federally on geographically-referenced data, and twice that spent at and local levels.

As is explained in the next section, the history of quantifying federal geospatial activities repeats every 30-40 years[15] (likely corresponding to the maturation of technology and work pattern lifecycles). The country is ripe for another government-wide attempt now. Paraphrasing the House Subcommittee Chairman Adam Putnam's questions at the hearing, we want to know "So how much does the country and the federal government spend on geospatial activities, and how is that money being spent now." As in prior generations, the answers would permit better use (and incentivize more effective use of) those resources in the public and private sectors.

---

[14] Committee on Government Reform Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census, *"Geospatial Information: A Progress Report on Improving Our Nation's Map-Related Data Infrastructure"* (June 10, 2003).

[15] OMB, Report of the Federal Mapping Task Force on Mapping, Charting, Geodesy and Surveying (1972) p. 81, refers to the 1935 report of the Science Advisory Board on state, county and local cooperation in federal mapping.

Chapter 6 **Short History of Quantifying Federal Geospatial Activities**

Efforts to quantify investments in or the value of spatial intelligence in government across the federal enterprise, or of the significance of any given initiative or program present a daunting task for which resources – human, institutional and financial – are largely unavailable. In their FY ’04 budget submissions, federal agencies were required under OMB Circular A-11 to submit details as to their geospatial data acquisition plans in excess of $1 million.[16] However, the responses to this request were largely inconclusive, as some agencies included all of their geospatial activities, and many only included specific staff or outsourcing arrangements.

In 1933, for the first time the Science Advisory Board attempted a government-wide assessment and found a proliferation and duplication of efforts – much like we see now.

In 1973, the OMB’s Federal Mapping Task Force on Mapping, Charting, Geodesy and Surveying[17] looked at defense and civilian activities:

- creating 8 specialized working groups to collect data and assess well-defined areas of activity, and distilled a series of reports on each area:
    1. Resource Identification
    2. Requirements Analysis
    3. Imagery & Photogrammetry
    4. Geodesy & Surveying
    5. Marine Surveys
    6. Data & Information
    7. Cartography & Printing
    8. Security
- sponsored two detailed requirements reviews getting at responsiveness, completeness and worth of major products produced for the user community
- solicited and collected 1,200 questionnaire responses from users of federal products

The 1973 Task Force recommended consolidating selected functions and programs under a new strong central mapping agency to make better use of the $446.8 million in FY ‘1972 spent on mapping, charting, geodesy and related activities (**MC&G**), entailing 17,384 man-years[18] strewn across 39 agencies. While US Geological Survey and the National Ocean Survey were the most visible, national homes for MC&G, they amounted to only $90 million and 4,300 man-years of the government-wide inventory of activities, and perhaps obscured $48 million spent at HUD, FHWA and NSF, with the remaining $162 million spent in the other 34 agencies.

---

[16] OMB Circular A-11 Part 7: *Planning, Budgeting and Management of Capital Assets* (July 2003), Paragraph II A 2 D, Section 300-30, http://www.cio.gov/documents/s300.pdf.

[17] OMB, Report of the Federal Mapping Task Force on Mapping, Charting, Geodesy and Surveying (July 1973), herein referred to as the **1973 Report**.

[18] This measure – “man-years” – reflects the culture of language then in 1972, and presumably reflects equivalent years of effort by men and women in MC&G.

Inflation adjusts a $1 in FY 1972 into $4.45 today.[19] Likewise, the missions, personnel and budgets of the agencies studied in 1972 have expanded over the past 30 years (mission growth), and what we mean by *spatial intelligence* in government operations implies a larger scope of activities and budget dollars spent using modern technology methods and products on government employees, operations and contracts than what the Task Force counted as MC&G (scoping growth).

[19] 1972 dollars inflated to 2004 dollars at $4.45 in 2004 per $1 in 1972, the rate given by Bureau of Labor Statistics Inflation Calculator, http://data.bls.gov/cgi-bin/cpicalc.pl.

Chapter 7 **Understanding 1973 Report in Our Context Today**

While it does not enjoy the predictive benefits of the prior quantitative discussion, there is a "rough cut" approach for using the findings of the 1973 Task in current dollars[20] once we make three adjustments:

1. **Inflation** – Assume that an FY '1972 $1 is worth $4.40 in FY '2003 and $4.45 in FY '2004
2. **Mission Growth** – assume that an agency studied in 1972 (as absorbed since then) would have the overall budget of the same agency or its successor in FY '2004, with the concomitant growth in its budget. While the total federal workforce of FTEs declined 11.8% in the past 31 years, the total budgets (adjusted for inflation) grew 112%, reflecting the trend towards outsourcing, as shown in the following Table.[21] Since the 1973 Report contains statistics on the civilian agencies MC&G, the rate of growth for civilian agency budgets – 162.56% - should be used.

Figure 8 Growth in Federal Agencies

Federal Executive Branch	1972	2003	Change
Total Workforce (thousands)	2,117	1,867	-11.81%
Defense (thousands)	1,108	636	-42.60%
Civilian Agencies (thousands)	1,009	1,231	22.00%
Total Budget (millions in constant 2003 dollars)	$1,012,040	$2,149,087	112.35%
Defense (millions in constant 2003 dollars)	$341,638	$388,870	13.83%
Civilian (millions in constant 2003 dollars)	$670,402	$1,760,217	162.56%

3. **Scoping Growth through Technology Advances & Program Demands** – Users[22] today demand spatial intelligence new applications, databases, Internet-ready portals and supporting personnel and infrastructure. Many were not conceived or available in 1972. These costs (new demands) would be in addition to what the 1973 Task Force inventoried as Mapping, Charting & Geodesy (**MC&G**). Simultaneously, 1972-era MC&G costs may have declined due to

[20] This approach was inspired by OMB's Jason Freihage and FGDC's Milo Robinson presentation at the FGDC Steering Committee meeting on June 6, 2003.

[21] OMB, *Budget FY 2005: Historical Tables - Total Executive Branch Civilian Employees*, Table 17.1 and Outlays by Agency, Table 4.1, http://www.whitehouse.gov/omb/budget/fy2005/pdf/hist.pdf. While the 1973 Report's quantitative data was archived, research has yet to find where it was stored. Moreover, the re-organization of federal agency functions since 1972 is not identified in sufficient detail (i.e., below the level of Cabinet Departments) to enable allocating personnel and budget numbers since 1972 to follow their agency host. Currently, therefore, it is impossible to allocate post-1972 increases in agency personnel and budgets to the categories of expenditure identified in the 1973 Report. Thus, the scaling factor of 162.56% applicable to the growth in the entire federal government's civilian budget (rather than specific Departments and agencies) has been used.

[22] The numbers thus far reflect the increasing amount and steady concentration of spatial investments in the 1972 MC&G agencies to service demand. However, many more agencies and programs beyond the MC&G agency functions have invested in spatial readiness since 1972. We assume those additional investments are dispersed throughout the federal enterprise and should be reflected as a net increase in scope.

current investments in automated technologies and outsourcing (efficiency savings). New demands exceeding efficiency savings would represent a net increase in expenditure. Assume that the net increase is roughly 15% of what was spent by those agencies in FY '1972.

Figure 9 projects the 1973 Report's findings into today's context[23]:

Figure 9 Projecting 1973 Findings into Today

1972 Federal Activities	Total 1972 Activity	Land Surveys	Land Mapping	Marine Mapping, Charting & Related Surveys	Technical Services
Agencies Involved	39	28	28	17	
Personnel (man years)	17,384	4,282	5,844	5,371	
Expenditures (millions 1972 dollars)	$446.81	$74.90	$112.90	$219.56	$92.20
Expenditures in millions 2004 dollars (where $1 1972 = $4.45 in 2004)	$1,988.31	$333.29	$502.38	$977.04	$410.29
Plus: Increase in Civilian Federal Budget since 1972 (162.56%) in millions 2004 dollars	$3,232.20	$541.80	$816.67	$1,588.28	$666.97
Plus: Increased Scale & Scope of Spatial Readiness Applications (assumed 15%) in millions 2004 dollars	$298.25	$49.99	$75.36	$146.56	$61.54
Total 1972 Expenditures Projected into 2004 million dollars (Columns D, E & F)	$5,518.75	$925.08	$1,394.41	$2,711.88	$1,138.80

In addition to the projections of federal agency spending on MC&G, we can assume that the intergovernmental transfers from federal to state, local and tribal governments are managed using spatial investments as would be at least as appropriate were the federal agency to perform the service function directly. Thus, each intergovernmental transfer dollar in FY2002 begets a percentage investment in geospatial activity resembling that of the federal government (if not more spatial).

If GOS costs roughly $5 million per year for 7 years and 1972 MC&G expenditures scale to $5.5 billion in 2004 dollars, then GOS' costs represents 0.09% ($5 million / $5.5 billion) of the projected costs. It is difficult to imagine a scenario whereby the benefits of GOS in aligning federal MC&G efforts would not save at least 0.09%.

[23] Appendix A sets forth a more detailed view of the 1973 MC&G Report's activities today.

Various aspects of GOS implement or address specific recommendations of the 1973 Report to OMB as follows:

- Insular, dispersed members of the MC&G/spatial readiness community act as islands of data instead of servicing the federal enterprise or state, local and public users[24]
- OMB Circular A-16 has only been partially successful in coordinating federal activities, largely because there is no interdepartmental overview or context for seeing spatial intelligence needs and capabilities inside and outside of government[25]
- Fragmentation of federal MC&G/spatial readiness investments has grown proportionately with agency budgets and missions[26]
- Advanced technologies available to the military MC&G/spatial readiness users are not rapidly exploited by civilian agencies due to lack of knowledge, security restrictions or budgets, resulting in further inefficiencies and waste for civilian agency functions[27]
- Civilian agency research and development efforts are likewise fragmented and ignores opportunities for merging procurements inside civilian or with defense efforts[28]
- "Among the urgent unmet needs is one for a rationalization of community activities for data and information systems. Separate systems using a variety of reference bases are being established with little or no correlation at great cost. Users of MC&G data now must query many different locations for assurance that they have all the official data available for their areas of interest. A central data information facility is needed to access, evaluate, store, retrieve and disseminate Federal holdings of imagery, geodetic and survey control, maps, charts and spatially-related data on a common reference base."[29]
- "Another unmet need is that of a national urban surveying and mapping program to support a host of Federal programs involved in the development of urban areas. A major HUD official outlined the need for 'direction in developing a common mapping methodology which could be used uniformly by all Federal agencies and A-95 clearinghouses serving the Nation's communities and also meeting their own mapping requirements.' What is needed is a national-scale urban mapping and surveying effort with clearly defined Federal standards. The mapping should be accomplished by commercial firms under contracts monitored by the responsible Federal MC&G agency."[30]

---

24 1973 Report, pp. 3, 6-7.
25 1973 Report, p. 3.
26 1973 Report, p. 3.
27 1973 Report, p. 7.
28 1973 Report, p. 8.
29 1973 Report, p. 9.
30 1973 Report, p.9.

Chapter 8 **Enhancing Spatial Readiness**

Throughout the literature of geospatial economics, various formulations describe what may be called *spatial readiness* – the degree to which an organization knows the spatial context in which it will make, implement and measure the performance of a decision. Some agencies use paper maps or rely on first-hand knowledge of location, without much digital enhancement. These agencies may be perfectly competent to make decisions affecting few other actors and requiring coordination with or approval from few other groups. Other agencies have vast digital spatial data and analytic capacities, sharable across multi-agencies using standardized data, metadata and information architectures. Looking at technical differences alone, measurable differences in spatial readiness may not be that great.

As the complexity for decisions increases, any individual agency's capacity and budget to self-assure spatial readiness (i.e., knowing all it needs to know about a place to make reliably effective decisions) becomes self-limiting, requiring reliance on a greater number of spatially-ready collaborators to "tell the whole story" about the place where something is happening. Thus, spatial readiness is a function of (1) whether an individual agency has all the spatial intelligence it needs, plus (2) whether its partners in approving, funding and implementing related decisions in real-time simultaneously have and share a like amount of spatial readiness. Emergency response illustrates the highest degree of these dual aspects of spatial readiness (inside and across agencies). But non-emergency settings of public health, environmental and other sub-functions call on spatial readiness as well. Any initiative (like GOS) that accelerates higher averages of spatial readiness increases the measurable output of government, namely responsiveness in real-time.

Figure 10 Extent of Known Homeland Security Datasets for Urbanized Areas (October 2003)

Gaps in spatial readiness affect intergovernmental operations every day. For example, the needs of the Department of Homeland Security for spatial intelligence prior to and after an incident are particularly acute.[31] Preliminary partial survey results[32] for 134 major urbanized areas call into question if there is any data (the red dots ●) and how much (the blue

[31] NIMA & USGS, *Homeland Security Infrastructure Program, TIGER Team Report* (Version 1.0 September 2002), available at hsip@nima.mil and hsip@usgs.gov.

[32] Preliminary Survey Results provided by USGS David Roberts on October 27, 2003, with the following caveats:

> "The information was gathered by the USGS state liaisons who contacted cities and counties and requested what data sources they had that could be made accessible to Federal agencies in the HSIP [Homeland Security Information Program]. I cannot verify that all available local data layers are entered into the database or that the information in the database is correct. This Inventory is a work in progress and as new information is discovered, it is added to the database. This type of data should be managed by the locals for

dots ●) of the minimum essential data sets (**MEDS**) required by federal participants in homeland security and emergency response operations (1) exists or (2) is known to exist. This finding underscores the immediacy of:

- improving discovery of spatial data holdings,
- standardizing those holdings for use and
- aligning the financing, acquisition and maintenance of key spatial data at the most local level so that it can be shared intergovernmentally.

Assuming full implementation and acceptance, GOS appears a strong step in addressing such concerns.

GOS. The purpose of this Inventory is to make Federal agencies, principally NIMA and USGS, aware that local data exists and to open the door to future partnerships to maintain the data."

Chapter 9 **GOS' Value to the Federal Enterprise Architecture**

Beginning with FY '04,[33] OMB is evaluating agency enterprise architectures against the FEA. Spatial information systems and data collection activities in pursuit of the National Spatial Data Infrastructure (**NSDI**) will be similarly evaluated. Since GOS' value will be realized in FY '05 and later years, the FEA BRM provides a pragmatic framework for summarizing GOS' value.

Version 2.0 of the BRM architecture suggests the federal government performs four business areas comprised of 39 lines of business, which lines of business entail some or all of 153 distinct sub-functions.[34] Each sub-function is assumed to deal with a particular location-dependent element (i.e., where to build a road, steward a water supply, protect public health risks, encourage economic development, etc.) In Step One, the FEA and BRM were used to suggest the spatial information needs, practices and interdependencies of the federal enterprise.

Step One suggested the spatial components of decisions, in essence their "*spatial-ness*", and how across thousands of decisions in the federal work year, finding and using up-to-date spatial data would reduce the federal costs of making the decisions (economies of scale) and increase the likelihood that each government decision was contextually relevant (i.e. met citizen or business needs) and leveraged locally-available resources and expertise (effectiveness, economies of scope or opportunity benefits). The economics of the spatial portion of decisions valued in Step One are affected by the modules of GOS in Step Two.

The value of spatially-enabling decisions that implement BRM sub-functions likely varies with each sub-function. Economic development uses different scales and layers of spatial data (property locations, types, features, labor availability, climate, etc.) and different applications shared by multiple parties (brokers, banks, economic development agencies, etc.) than building a road or restoring a wetland. Theoretically, each BRM sub-function would implicitly have a baseline level of spatial thinking, whereby (A) investments across the federal enterprise to achieve less spatial thinking would be seen as too little to efficiently and effectively perform or participate in that sub-function, and (B) investments above that level would be cause for inquiry into the special spatial needs of a particular agency's performance of the sub-function. Given the transitions involved in moving agency enterprise architectures to the FEA, the latest version of the BRM does not specifically suggest such baselines.

Given the lack of current data on how spatial investments line up with BRM functions, it is not possible to portray them with empirical certainty. The preparers of this report had suggested interviewing federal chief information officers (CIOs) and geographic

[33] OMB, *Implementing the President's Management Agenda for E-Government* (April 2003), p. 17, http://www.cio.gov/documents/2003egov_strat.pdf.

[34] Federal Enterprise Architecture Program Management Office (FEAPMO), The Business Reference Model Version 2.0 – A Foundation for Government-wide Improvement (June 2003), http://www.feapmo.gov/resources/fea_brm_release_document_rev_2.pdf.

information officers (GIOs) to obtain empirical support for assumptions tying spatial investments to GOS.

For purposes of valuing GOS in the FEA setting, experience and review of other studies formulate some very preliminary assumptions and constraints:

1. Each Sub-function's Spatial Needs are Persistent - Within each BRM sub-function of an agency, spatial information is optimally useful at a constant rate. Environmental management whether the responsibility of Bureau of Land Management on federal lands or EPA along the Chesapeake Bay likely requires a constant rate of spatial information.
2. The Extent of each Sub-function's Spatial Needs are Distinct - Two BRM sub-functions may optimally use spatial information at different rates. Environmental management and transfers to states and local governments are both essential EPA sub-functions, but each uses spatial information at different rates.
3. Spatial Data Needs Scale with Agency's Sub-function Budget Size - The rate of investment in spatial information intensifies to reflect the level of agency budgets for each BRM sub-function, so that agencies expending more on a sub-function require today (without GOS) greater investments in spatial information services and data. Building National Integrated Land System (**NILS**) for the Bureau of Land Management to manage 254 million acres of surface public lands and 700 million acres of subsurface mineral rights.[35] NILS reflects the attendant use of spatial information in BLM's property management operations, as compared to the USGS' direct responsibility for knowledge creation and management through its national mapping activities.
4. As Sub-Functions become more Local, They Demand More Spatial Data - Spatial data needs for each BRM sub-function (i.e., at the right extent, scale and timeliness to support a decision) intensify as the federal agency's decision process involves more localized issues. For instance, the agency-wide budgeting sub-function does not depend on local spatial data, whereas cleaning up an EPA superfund site or FEMA's response to an emergency does. Of the four business areas, BRM sub-functions involved in Services to Citizens are the most localized, and therefore the most dependent on spatial data for decision support – making them likely the richest source of efficiency and effectiveness gains.
5. Sub-function Transactions Generate High-Value Spatial Data – As with other data types generated through government operations, spatial data can be updated "on-the-fly" at low additional marginal cost depending on how components for a sub-function applications are standardized and architected. The FEA's Technical Reference (**TRM**) and Performance Reference (**PRM**) Models offer the potential for standardizing and gathering transactional datasets, consistent with the Federal Geographic Data Committee's National Spatial Data Infrastructure has long envisioned.
6. Spatial Data Ages Commensurate with the Rate of its Use – Within a region, data used most ages fastest. Features associated with street addresses age quickly,

[35] ESRI, *Press Release: ESRI, BLM, and USDA Forest Service Deploy GeoCommunicator* (October 11, 2001, http://www.esri.com/news/releases/01_4qtr/esri-blm-usda.html.

whereas the name of a mountain and its geology age slowly. Thus, agencies budgeting for spatial data support of sub-functions that use high-turnover datasets have to budget more for updating those datasets, and would save more from alternative arrangements whereby refreshed data is consistently assured.

7. Spatial Data Redundancies Today Reflect the Age & Diversity of First Implementations – Agencies that invested earliest in spatial information systems *without* enterprise-wide strategic plans likely have the highest concentrations of disparate systems serving single programs within and across BRM sub-functions. Viewed positively, early adopter programs have proportionately more efficiency and effectiveness to gain through enterprise-wide geospatial alignment efforts (i.e., interoperability, data standards, bulk procurement, one stop master partnerships, etc.)

The assumptions represent a partial set of pre-existing conditions for GOS. Each module of GOS either addresses or is limited by each assumption. For instance, the extent of agency sub-functions dependent on spatial intelligence reduces and prioritizes the universe of federal functions through which GOS might arrange partnerships and align investments in spatial data. Likewise, agencies without extensive budgets or commitments to legacy spatial information architectures may find GOS a ready-made solution bringing a portal and standards for significant datasets, and leaving more seasoned spatial information players in the federal establishment behind in transitioning to FEA's interoperability.

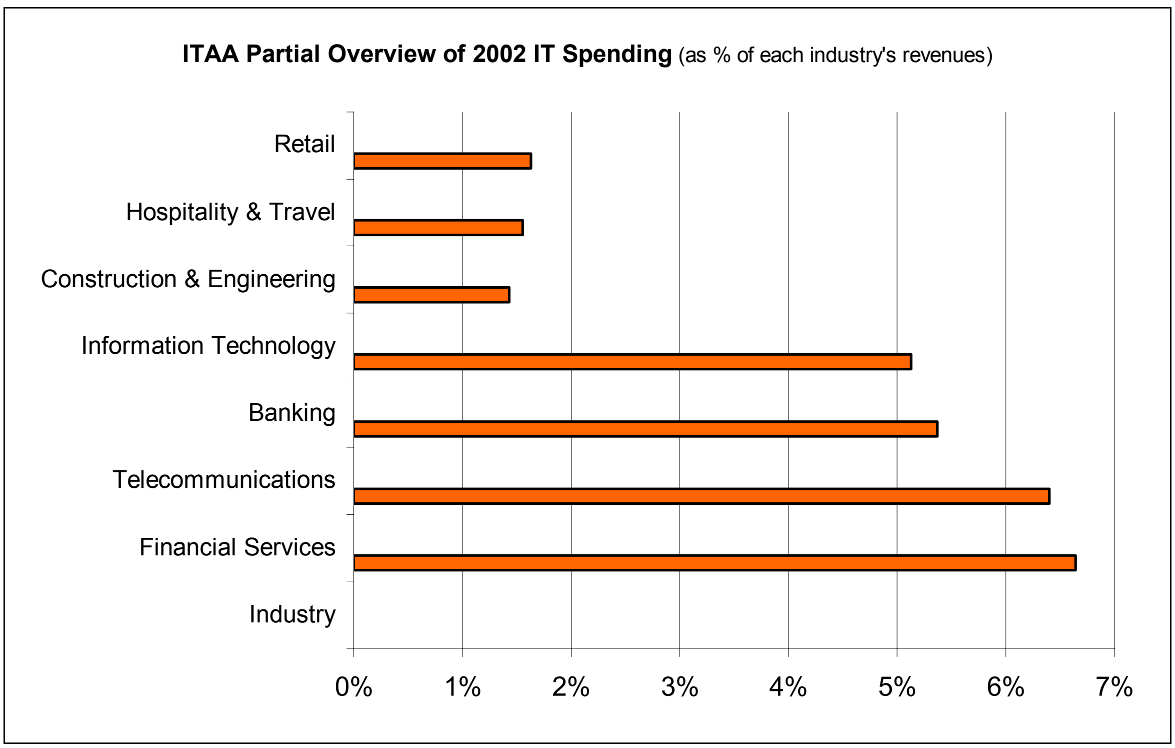
Chapter 10 Sketching an FEA BRM Spatial Intelligence Performance Model

With these assumptions and constraints as a starting point, the next steps to develop a working model for GOS' impacts would be as follows:

1. Using the assumptions and constraints as the starting points, describe each BRM sub-functions as now spatially-enabled within each agency or program.
2. Summarize the level of business process activity within and across all sub-functions (i.e., the program dollars, FTEs or other inputs reflecting transactions)
3. Derive the spatial-intelligence of the BRM sub-function for the agency
4. Average the spatial-intelligence of all agencies' spatial intelligence sub-function scores
5. Mathematically depict the impacts of GOS modules on removing assumptions and constraints within each BRM sub-function
6. Apply the GOS module to each agency's sub-functions

Assigning "spatial intelligence" rates to individual agency sub-functions resembles assigning IT rates. The Information Technology Association of America's Overview of the US IT Industry suggests information technology spending rates (in percentage of 2002 revenues spent on IT) for the private sector as follows:[36]

Figure 11 IT Spending Rates Across Industries (2002)



[36] ITAA, *US Information Technology Industry: A Brief Overview*, http://www.itaa.org/news/gendoc.cfm?DocID=120.

ITAA's survey of private IT spending suggests that each industry's cultural penchant to adopt IT varies. Likewise, the BRM sub-functions should vary in their absorption rates/spending rates on IT (and by extension, spatial intelligence).

The Commerce Department[37] reports the IT intensity of US industries, and finds that between 1989 and 2000 found that more IT-intensive industries far outperformed less IT-intensive industries as follows:

Figure 12 Effect of IT-Intensity on Productivity

Nonfarm Industry Statistics	More IT-Intensive Industries	Less IT-Intensive Industries	Net Effect of IT Intensity
Productivity Growth	2.95%	0.58%	408% increase in productivity growth
Portion of Nonfarm GDP Growth from Industry	1.68%	0.01%	Almost entire gain in GDP growth nationally from IT-Intensive industries
Output Growth (GDP per industry)	4.75%	2.74%	73% higher growth in output for IT-Intensive industries
FTE Growth	1.75%	2.14%	18% fewer workers needed in IT-Intensive industries

---

[37] U.S. Department of Commerce, *Digital Economy 2002*, http://www.esa.doc.gov/pdf/DE2002r1.pdf, pp. 32-8.
Research has yet to discover similar statistics for comparable IT-intensity of farm-related industries and employees. Agricultural technology includes soils and resource conservation/optimization, planting and harvest management, crop and pest controls, environmental and waste management, transportation improvements and a host of other applications beyond nonfarm information technology. Examples of universal technology adoption in farm and nonfarm sectors also exist. For instance, the US Department of Agriculture has articulated the value of imagery and other geospatial products and services as means to increase the certainty, safety and yield of crop and livestock operations. See, USDA National Agricultural Statistics Services, *History of Remote Sensing for Crop Acreage*, http://www.usda.gov/nass/nassinfo/remotehistory.htm. Farm operators - family and large agribusinesses alike – judge technology benefits not just by greater productivity but in terms of the savings in management's time. USDA Economic Research Service, *Does Off-Farm Work Hinder "Smart" Farming?* (Agricultural Outlook - September 2002), http://www.ers.usda.gov/publications/agoutlook/sep2002/ao294i.pdf. Agricultural technology includes planting and harvest management, crop and pest controls, environmental management, transportation improvements and a host of other applications. Like other innovations, precision farming's IT-intensity benefits depend on pooling information flows:

> Who benefits from precision farming will be determined by how management of precision data is organized. To realize the full benefit from precision farming farmers will probably need to pool data. You can not try every alternative on your farm, but by pooling data with other farmers who have different management approaches it will be possible to identify the best combination of seed, fertility, tillage and pest control.

Quoted from Jess Lowenberg-DeBoer, *Economics Of Precision Farming:Payoff In The Future* (Purdue University - February 1996, http://www.lars.purdue.edu/SSMC/Frames/economic_issues.html.

Nonfarm Industry Statistics	More IT-Intensive Industries	Less IT-Intensive Industries	Net Effect of IT Intensity
Inflation in Price of Goods & Services	1.26%	3.01%	58% less inflation, making IT-Industry products and services more affordable and restraining inflationary pressures on the national economy

The IT-intensity of industry may reflect or forecast IT-intensity in government,[38] and suggest the range of e-government gains from adoption of the BRM, and in turn spatially-enabling the BRM. The relative IT-intensity of industry-customers for government services (among other factors) drives demand for corresponding IT-intensity in government agencies and programs serving those industries and workers in those industries. A highly IT-intensive industry – like telephone and telegraph would likely demand more IT adoption faster by governments than a low intensity industry such as Educational services.[39] Likewise, since often government employees for particular agencies are hired from and return to private sector employment in their industry specialty, those employees while in government service may demand a concomitant level of IT while performing and pursuing government BRM activities.

One could conceive a four step methodology for valuing the benefits of GOS or any other initiative or advance in geospatial utility through technology, finance, data or organizational activities:

Figure 13 Valuing Benefits of GOS

Valuation Step	IT Budget Benefits	Non-IT Budget Benefits
1. Basic Macroeconomics of Federal Budget	What % of IT Budget is spatial & could be saved?	How would FTEs, non-IT capital, land and other factors result in greater productivity gains at less risk?
2. Adding Granularity of BRM to see Federal Government through Agency Sub-functions	What % of IT Budget is spatial & could be saved?	How would FTEs, non-IT capital, land and other factors result in greater productivity gains at less risk?
3. Adding Intergovernmental Cooperation & Collaboration through State, County, Local & Tribal delegations of or autonomy for Sub-functions	What % of IT Budget is spatial & could be saved?	How would FTEs, non-IT capital, land and other factors result in greater productivity gains at less risk?

[38] Research has not uncovered similar statistics on the IT-intensity of government activities. Until such statistics are available, the private sector figures serve as a guide for the likely benefits of applying industry's information technology gains to corresponding government activities.

[39] U.S. Department of Commerce, *Digital Economy 2002*, http://www.esa.doc.gov/pdf/DE2002r1.pdf, Table 4.1, p. 35.

Valuation Step	IT Budget Benefits	Non-IT Budget Benefits
4. Adding Regionalism to realize Economies of Scale outside of Public Goods benefits by Improving Public-Private Alignments	What % of IT Budget is spatial & could be saved?	How would FTEs, non-IT capital, land and other factors result in greater productivity gains at less risk?

GOS' benefits derive from how much faster and more completely the enterprises in each Step realize the benefits in their IT and non-IT Budgets through delivery of GOS' modules. For instance, if Step 1 is worth $100 million per year savings (assuming, 25% from IT-budget benefits and 75% from non-IT budget benefits) and GOS speeds reaching that level of benefits one year earlier, then GOS adds the net present value of $100 million annually (less allocable costs) to Step 1.

Quantitative data for running this valuation analysis is sketchy at best, and time and other institutional constraints have focused attention on estimating the benefits through Steps 1 and 2.

To illustrate the cross-walk between Commerce Department IT-intensity rates and BRM sub-functions, the following scenario suggests an appropriate apples-to-apples concordance.

Figure 14 BRM Scenario for Portraying Spatial Readiness Savings

Major BRM Categories	BRM IT Budgets	BRM Non-IT Budgets	Assumed Portion of IT Budget Spent on Data for Spatial Readiness (@ 7%)	Assumed Portion of Non-IT Budget that Depends on Spatial Readiness (@ 20%)	Value of Saving 1% of IT Budget Spent on Spatial Readiness	Value of Saving 1% of Non-IT Budget that Depends on Spatial Readiness
Community and Social Services	$1,739	$128,635	$122	$25,727	$1	$257
Correctional Activities	$212	$2,534	$15	$507	$0	$5
Defense and National Security	$20,925	$302,175	$1,465	$60,435	$15	$604
Disaster Management	$3,554	$103,768	$249	$20,754	$2	$208
Economic Development	$1,404	$80,338	$98	$16,068	$1	$161
Education	$7,635	$141,071	$534	$28,214	$5	$282
Energy	$1,138	$11,249	$80	$2,250	$1	$22
Environmental Management	$1,309	$31,494	$92	$6,299	$1	$63

Major BRM Categories	BRM IT Budgets	BRM Non-IT Budgets	Assumed Portion of IT Budget Spent on Data for Spatial Readiness (@ 7%)	Assumed Portion of Non-IT Budget that Depends on Spatial Readiness (@ 20%)	Value of Saving 1% of IT Budget Spent on Spatial Readiness	Value of Saving 1% of Non-IT Budget that Depends on Spatial Readiness
General Science and Innovation	$745	$6,036	$52	$1,207	$1	$12
Health	$2,784	$216,247	$195	$43,249	$2	$432
Homeland Security	$1,478	$91,224	$103	$18,245	$1	$182
Income Security	$929	$223,894	$65	$44,779	$1	$448
Intelligence Operations	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
International Affairs and Commerce	$1,494	$143,429	$105	$28,686	$1	$287
Law Enforcement	$4,956	$241,371	$347	$48,274	$3	$483
Litigation and Judicial Activities	$2,983	$318,597	$209	$63,719	$2	$637
Natural Resources	$944	$53,526	$66	$10,705	$1	$107
Transportation	$737	$9,379	$52	$1,876	$1	$19
Workforce Management	$2,808	$199,706	$197	$39,941	$2	$399
*Revenue Collection	$1,133	$76,221	$79	$15,244	$1	$152
Totals	$58,907	$2,380,893	$4,123	$476,179	$41	$4,762

In this scenario ($41 IT-budget savings: $4,762 non-IT budget savings), the agency effectiveness and coordination needed to save an average $1 in spatial readiness investments for the IT budget yields spatial intelligence that translates to more than $116 in the non-IT budget. For example, aligning the spatial intelligence needed to site and build a federal road better might save $1 per road segment in compiling, updating and exchanging spatial data among many stakeholders, but might save $116 in the hard costs of building and maintaining the road. Because agency budgets spend so heavily on non-IT functions, the message from such analysis is clear:

- while GOS may result in savings for agency IT budgets (e.g., $1),
- GOS' far greater value may come through savings in effectiveness and efficiency savings in non-IT budgets (e.g., $116) where the full impacts of spatially-intelligent management choices are realized over time.

Chapter 11 Reviewing GOS' Intergovernmental Value Potential

The Center for Digital Government (**CDG**) regularly surveys and ranks states, counties and cities for their degree of technology use, implementation, savings and leadership. The surveys prioritize which government services are significant for technology implementation. CDG's Digital State, County and City surveys judge how well e-government strategies are being realized across eight categories:

1. Law Enforcement and the Courts
2. Social Services
3. Electronic Commerce and Business Regulation
4. Digital Democracy
5. Management and Administration
6. Taxation
7. Education and
8. GIS and Transportation

While GOS' spatial data standardization, access and use benefits accrue to all eight CDG digital government categories, the fact that GIS (a catch-phrase for spatial intelligence) is part of the eighth category suggests how important to non-federal governments spatial data support has become in gauging whether e-government is being achieved.

CDG's *Best of the Web*[40] scores government portals as follows:

Figure 15 Best of Web Scoring Categories for Government Portals

Score	Portal Review Category	Questions Asked in Reviewing Portal
20%	Innovation and use of Web-based technology to deliver government or education services	What is new or cutting edge about the site?
50%	Functionality (ease of use) and improved access	What steps have you taken to ensure customer satisfaction, easy navigation, and clean appearance? How intuitive is the interaction between government and citizens or between the educational institution and its students, teachers and parents? Where is your accessibility plan? Please state where we can find it. Where is your privacy and security statement? Please state where we can find it.
15%	Efficiency or time saved	How is what you are doing shaping government or education efficiencies? What has this website/application done to streamline services or business? Give specifics on how you have measured the efficiencies and time saved.
15%	Economy or money saved	Was innovative funding or a public/private partnership developed? How much did you save? What long term, continual savings have you projected?

40 CDG, *Best of the Web Scoring Rules*, http://www.centerdigitalgov.com/center/bestofweb03.php.

Future assessments of GOS' portal might utilize the CDG scoring criteria to objectively measure its utility.

Depending on the coverage, themes and scale of spatial data registered to and through GOS, GOS' portal (including the elements of the interoperable portal architecture it implements) will likely satisfy the CDG criteria, and enable agency portals to satisfy the same criteria. Raising the bar for spatially-enabled portal architecture, ease of use and design simultaneously across the federal enterprise means that GOS can help amplify collaboration benefits between and among BRM sub-function groupings to yield greater government responsiveness at lower cost. In essence, the weakest link (i.e., agency or sub-function with the lowest spatial readiness) is now better able to participate in spatial response than before.

Chapter 12 Evaluating GOS Modules in Light of Local Government Needs

GOS grew out of the President's Quick Silver analysis in the Summer of 2001 to identify e-government initiatives with the greatest potential for the federal enterprise in the G2G (government-to-government) segment of e-government. Thus, GOS' deliverables are attuned to federal requirements for nationally-scalable datasets. However, as will be seen, GOS can be a platform for federal agencies to better align with state and local government (as well as private sector) needs and strategies for spatial readiness.

A recent survey of local government implementation highlights certain corollary benefits and gaps in the GOS deliverables as seen from local government's perspective. In 2003, Public Technology Inc. surveyed 10,531 counties, cities and villages[41] regarding their implementation of GIS – Geographic Information Systems (**GIS**), the software moniker for spatial readiness.

While the resources for GOS cannot be expected to solve all problems within federal and non-federal communities relating to spatial readiness, the following table contrasts PTI's findings (in the first column) and how they are addressed by GOS' deliverables:

Figure 16 PTI 2003 Survey of Local Government GIS & GOS Modules

2003 PTI Survey Finding	Data Standards	Index of Federal Data	Partnering	Data Discovery & Accessibility	Federal Investment Strategy	Elements Outside GOS' Scope
Serious Financing Problems Exist for Local Government Spatial Readiness: 64% want but don't have funding to move forward[42]	Conformance to standards will be implicit requirement of federal program management & grants-in-aid	Finding federal data may limit data that local governments need to buy at their own cost	Federal agency commitments to partner can provide missing funding	Finding data may limit data local governments need at their own cost	While not yet defined, federal interest in investment strategy opens door to local government proposals	GOS does not have resources to directly fund local government spatial data development

[41] PTI, *National GIS Survey Results: 2003 Survey on the use of GIS Technology in US Local Governments*, http://www.geo-one-stop.gov/docs/survey/GIS_Survey_Report_Final_Nov03.pdf, (hereafter **PTI Survey**).

[42] PTI Survey, p. 7.

2003 PTI Survey Finding	Data Standards	Index of Federal Data	Partnering	Data Discovery & Accessibility	Federal Investment Strategy	Elements Outside GOS' Scope
Orphaned Infrastructure: Local governments that used grant funds to establish their GIS often lack the funding to maintain or enhance it, leaving thousands of applications to whither[43]			Partners – especially federal agencies – may more quickly & consistently justify funding data maintenance (i.e., digital ortho-photography, base mapping, etc.) once local data conforms to national standards			GOS has no funding to aid local governments with maintenance of conformant datasets
Partnering Good, but can be better: 44% of local governments participate in intergovernmental cooperative development and cost-sharing programs for base maps and layer building[44]			GOS Partnering mechanisms include its online Marketplace or other tools		By posting federal agency spatial data acquisition plans on GOS' portal, partnering options and opportunities should increase	No direct financial incentives nor regulatory penalties or incentives exist as part of GOS Metadata on spatial readiness investments does not yet exist to match investors & their known capacity & requirements for partnering

43 PTI, Survey, p. 10.
44 PTI Survey, p. 10.

2003 PTI Survey Finding	Data Standards	Index of Federal Data	Partnering	Data Discovery & Accessibility	Federal Investment Strategy	Elements Outside GOS' Scope
Partnering with federal government is routine & unanimously embraced: • 97% would share local data for floodplain mapping • 96% would share local data for land use & land cover programs • 97% would share local data for emergency preparedness & response			GOS has identified & is provides a forum to align separate data partnering activities of FEMA, USGS, EPA, Census and other agencies.	Metadata compliance & registry will assist local governments in providing federal government with low-cost access to their local data holdings	I-Team activities with and through states could be leveraged by GOS to improve speed and coverage of data sharing options for federal spatial data investors	GOS is not funded to incentivize local governments to register their data holdings through the GOS portal
Technical Barriers: • 42% want but don't have technical expertise to move forward[45] • 72% need subsidy to hire GIS consultants and 31% need volunteer GIS support[46]	Federal work to complete data standards improves likelihood that multi-use data will be successfully spec-ed & maintained	Finding federal data holdings brings access to the technical expertise of federal agency personnel responsible for maintaining it		Finding non-federal data holdings brings access to the technical expertise of personnel responsible for maintaining it	Procurement language and processes by which technical requirements for thematic data are more likely to be visualized and shared	Limited FGDC funding for cooperative programs that provide technical assistance

[45] PTI Survey, p.8.
[46] PTI Survey, p. 11.

2003 PTI Survey Finding	Data Standards	Index of Federal Data	Partnering	Data Discovery & Accessibility	Federal Investment Strategy	Elements Outside GOS' Scope
One-Third of Communities are missing out: 35% need to know more about the technology to decide whether to implement it[47]			GOS includes limited funding for outreach		Most of local government reticence may be unfamiliarity with success stories within federal & other governments. GOS can catalogue successful implementations.	
Smaller Have-Not Communities: While 97% of larger communities use GIS, only 57% of smaller communities (less than 50,000 population) use it[48]				Smaller communities can find & use federal & state datasets as "first-base" to implement GIS		No strategy for equalizing the basic level of implementation of spatial readiness
Proven ROI: At all levels of local government, GIS has proven its ROI[49]				GOS Portal could host ROI studies performed inside and outside of federal government & make them searchable by application area (emergency response, public health, environment, etc.) and geographic area of interest	Improves consistency in ROI analysis & statistics amongst federal agencies' OMB submissions	

47 PTI Survey, p. 8.
48 PTI Survey, p. 8.
49 PTI Survey, p. 9.

2003 PTI Survey Finding	Data Standards	Index of Federal Data	Partnering	Data Discovery & Accessibility	Federal Investment Strategy	Elements Outside GOS' Scope
Homeland Security (**HS**)[50] • 68% need GIS training of 1st responders • 80% need to build additional spatial data layers to support HS • 76% need to build new applications for HS • 66% need to improve how they maintain their spatial data for HS • 54% need more accurate data for HS • 43% need to hire more skilled staff • 98% would let federal agencies use local data for HS purposes[51]				Helps anticipate spatial data gaps & redundancies By knowing data sources, eases discovery of application areas (themes, regions) where significant development efforts can be saved copying & adapting existing software		GOS aids the Department of Homeland Security (**DHS**), but does not direct or control funding for HS activities to and within local government DHS formula grants have yet to provide incentives for coordinated spatial readiness investments Discovery of applications is not yet supported by GOS portal nor by national metadata

A recent study of GIS use for land use and transportation planning[52] illustrates the regional impacts of the needs identified in the PTI Study, concluding:

> [D]espite the major technological advancements in GIS and the extensive efforts expended in spatial data development at the local, regional, state, and national levels in the past decade, the state of the art in land market monitoring and metropolitan urban growth management and planning is far below what is now technically feasible. The primary impediments appear to be:
>
> - inadequate data availability and/or integration at the regional level,
> - limited infrastructure, and

[50] PTI Survey, p. 11.
[51] PTI Survey, p. 12.
[52] Gerrit-Jan Knaap & Zorica Nedovic-Budic, Assessment Of Regional GIS Capacity For Transportation And Land Use Planning (December 2003), http://www.urban.uiuc.edu/faculty/budic/W-metroGIS.htm (the **Regional Study**).

- institutional constraints.

GOS provides mechanisms for changing federal institutional culture to address and partner in solutions to most of these impediments.

Notably, though, two institutional constraints identified in the Regional Study - assured financing[53] and regional data sharing arrangements - are not directly incorporated into the GOS Modules, but readily could be.

Homeland security and integrating all-risk hazard response across federal-state-local realms provide ample reasons to immediately expand existing efforts at regional coordination and financing. As the Regional Study points out:[54]

> The opportunities for progress in this area lie primarily within the local and regional realms. Awareness about the common problems and about the value of comprehensive regional land monitoring and policy solutions to urban development is the underlying and necessary motivational factor. Creating institutional mechanisms and solutions to support regional GIS and planning is the single most important facilitating factor to achieving a sustainable information base and regular land monitoring activity.
>
> External stimuli may prove to be beneficial too. For example, state mandates and programs that relate to urban planning and to development of digital spatial information may generate the needed focus and resources.
>
> In addition, some of the ongoing national data initiatives led by the federal government (e.g., NIMA's focus on data for largest cities – "133 cities," USGS's "The National Map" program, and FGDC's "Geo-Spatial One Stop" project) have already contributed to raising recognition of the importance of locally developed and maintained datasets and their vertical integration at regional, state, and national geographies and scales.
>
> Finally, in light of the recent (post 9-11) increase in awareness about the importance of spatial data for responding to local emergencies, we must point out that a number of datasets inventoried in this research effort are relevant for homeland security. The findings of this assessment point to the needs for further action in building the national spatial data infrastructure (NSDI), and the local and metropolitan GIS capacity in particular, as its main building block. We suggest that development of multi-purpose databases that serve both civic and public safety needs is more efficient than focusing only on data that would support occasional incidents or decisions. Institutionalization of GIS technology and data and their use on a daily basis for a variety of public, private and non-profit sector functions is the most efficient way of developing, maintaining, and integrating the national datasets. Use of GIS for monitoring urban land markets and

53 Regional Study, p. 5.
54 Regional Study, p. 6.

development is one example of such GIS institutionalization and integration at the metropolitan level.

GOS will impact local government spatial readiness to some degree, and could address concerns raised in the PTI Survey and Regional Study if the institutional leadership and culture shifts needed for GOS' success take root in daily intergovernmental relations. From an economic perspective, GOS' value regionally would be "icing on the cake," since GOS is focused primarily on aligning disparate spatial readiness efforts throughout the federal enterprise.

Chapter 13 **GOS and the Federal Spatial Readiness Marketplace**

Within the federal agencies and the vendors serving them, there often has been heated debate about the effect that interoperable standards might have on those companies providing software, hardware and data in largely proprietary formats. Some say that the federal government pays too much for the spatial intelligence it receives because proprietary standards either:

- reduce competitiveness for vendors to bid alternative solutions, or
- support an integrated set of software applications that provide the normal and advanced user with an economic solution to many common tasks.

This Report recognizes that traditionally[55] the federal government has chosen competitiveness over claims of higher utility in that debate. OMB Circulars and initiatives such as the NSDI and GOS seek to promote a set of interoperable standards for data use and reuse, and with those standards and set of interoperable standards for software, hardware and networks to drive reusable data throughout the federal enterprise.

So the question might be asked: Does the movement toward interoperability promote competitiveness within the federal spatial readiness marketplace (and therefore result in more effective procurement "bang for the buck")? An analysis[56] of the Federal Procurement Data for the years FY 2000 – 2003 is enlightening in this regard.

---

[55] Depending on how agency requirements are solicited for inclusion in bulk bidding, a potential de facto shift in this preference for competition may be the recently announced SmartBuy program. Jason Miller, *OMB, GSA to push for bulk buys of software* (Government Computer News - May 26, 2003), http://www.gcn.com/22_12/news/22189-1.html.

[56] This analysis was performed by doing the following:

- Assembling a list of 1,363 names for companies, nonprofits and universities known to be active in the spatial readiness marketplace, based on websites for leading associations, conferences and other groups
- Obtaining the Federal Procurement Data (**FPDS**) for FY 2000 – 2003 (third quarter)
- Determining the Product Service Codes (**PSC**) for contracts awarded to the known spatial vendors
- Calculating the total and average dollar amount of contracts they obtained for each PSC

This analysis and the results cited herein are preliminary and – if time and resources permitted - ideally would be refined for a number of reasons, including:

- FPDS data that is as yet unavailable and is still forthcoming for the 4th quarter of FY 2003
- Ongoing research to confirm and conform the field names and scale of dollar amounts (thousands of dollars vs raw dollars) as used in the FPDS data
- Ongoing research to automate tracing FPDS contract data back to the actual program funding such contracts so as to group FPDS amounts with the FEA BRM sub-functions (see Chapter 9
- Ongoing research to both
    - (A) refine the amounts shown as spatial that relate to non-spatial activities (i.e., building a general Oracle database system) and
    - (B) determine where spatial readiness components are part of larger procurements (i.e., building the navigation data and system for a Navy destroyer, where the contract is listed only under the prime contractor's name).
- Ongoing research to map the FPDS amounts to the place covered by contracts for spatial readiness

Figure 17 shows the product service classifications (**PSC**s) used by known spatial technology companies, nonprofits and academia and the associated volume of federal contracts by agencies in FY 2002.[57] This summary of federal procurement activity demonstrates the diversity and financial impact of spatial readiness buying habits across the federal marketplace, and suggests the significant savings opportunities that GOS and other initiatives might create by leveraging federal agency procurements.

Figure 17 PSCs used by Known Spatial Technology Providers in FY 2002

PSC	PSC Descriptive Name	Contract Dollars (Thousands)
T009	Aerial Photographic Services	$7,288
B502	Air Quality Analyses	$14,852
D317	Auto News, Data & Other Services	$107,561
D307	Automated Information System Services	$1,182,101
T002	Cartography Services	$2,210
B553	Communications Studies	$13,179
D313	Computer Aided Design/Mfg Services	$358,050
R702	Data Collection Services	$63,298
F110	Dev Environmental Impact Stmt/Assess	$72,969
R425	Engineering And Technical Services	$7,806,207
B517	Geological Studies	$3,356
6655	Geophysical Instruments	$7,060
R423	Intelligence Services	$11,326
J070	Maintenance - Repair Of ADP Eq & Supplies	$602,233
J066	Maintenance - Repair Of Instruments & Lab Eq	$273,426
J099	Maintenance - Repair Of Misc. Equipment	$924,082
J074	Maintenance - Repair Of Office Machines	$48,614
7640	Maps, Atlases, Charts, And Globes	$83,705
5895	Misc Communication Equipment	$1,177,810
1290	Misc Fire Cont Equipment	$47,275
9999	Miscellaneous Items	$543,554
1680	Misc. Aircraft Accessories Comps	$1,279,685
K070	Mod Of ADP Equipment & Supplies	$3,911
5999	Msc Elect & Electronic Components	$543,167
F111	Mult Pol Ind Invst Surv/Tech Sup	$9,568
6605	Navigational Instruments	$90,712

[57] Figure 17 should not be read as the total spatial readiness purchases by federal agencies for FY 2002. Each PSC contract buys a varying degree of spatial readiness. For instance, it seems fair to say that 100% of contracts categorized as PSC T002 for Cartography Services and PSC 7640 for Maps, Atlases, Charts and Globes provide spatial readiness to customer agencies. However, only 25% or even 5% of contracts for PSC AR21 R&D-Space Science & Appl-B Res or B510 Study/Environmental Assessments might be construed as spatial readiness investments. Moreover, Figure 17 leaves out PSCs used by, say, Northrup Grumman or other defense contractors to provide Navy battleships, presumably with navigational tools and cannot trace subcontracting below major PSC classification for components of larger contracts coded differently which components are spatial In nature. Thus, this chart both is over- and under-inclusive, given the nature of the FPDS data from which it was derived. OMB and GSA will improve the value of the FPDS data with their next generation (FPDS-NG) efforts.

PSC	PSC Descriptive Name	Contract Dollars (Thousands)
5855	Night Vision Eq	$432,976
6930	Operation Training Devices	$273,609
R405	Operations Research & Quantitative	$41,199
6650	Optical Instruments	$67,895
1240	Optical Sighting & Ranging Equipment	$156,809
D399	Other ADP & Telecommunications Services	$6,946,222
C219	Other Architects & Engineering Genl	$866,618
AD93	Other Defense (Advanced)	$2,763,593
AD92	Other Defense (Applied/Exploratory)	$1,160,647
AD91	Other Defense (Basic)	$388,953
AD94	Other Defense (Engineering)	$121,910
AD96	Other Defense (Management/Support)	$145,056
AD95	Other Defense (Operational)	$350,372
U099	Other Education & Training Services	$408,901
F999	Other Environmental Services, Studies or Support	$891,207
R799	Other Management Support Services	$1,604,239
F099	Other Natural Resources Mgmt & Conservation	$109,390
T099	Other Photo Mapping Printing Svc	$64,488
R499	Other Professional Services	$2,919,713
B599	Other Special Studies And Analyses	$570,541
T008	Photogrammetry Services	$2,528
6760	Photographic Eq & Accessories	$23,398
6730	Photographic Projection Equipment	$31,349
6750	Photographic Supplies	$13,174
R406	Policy Review/Development Services	$73,200
R404	Prof Services/Land Surveys - Cadastral	$21,971
R415	Prof Services/Tech Sharing-Util	$174,456
R427	Prof Services/Weather Rpt-Observ	$10,897
D308	Programming Services	$392,018
AC62	R&D-Electronics & Comm Eq-A Res/Exp	$305,867
AJ21	R&D-Math & Computer Sci-B Res	$33,586
AZ12	R&D-Other R & D-A Res/Expl Dev	$328,680
AZ11	R&D-Other R & D-B Res	$868,397
AZ14	R&D-Other R & D-Eng Dev	$237,012
AR21	R&D-Space Science & Appl-B Res	$363,660
5841	Radar Equipment, Airborne	$529,673
5821	Radio & Tv Eq Airborne	$363,679
5825	Radio Navigation Eq - Except Air	$77,677
5820	Radio TV Equipment except Airborne	$555,699
B529	Scientific Data Studies	$79,038
AD22	Services (Applied/Exploratory)	$181,468
AD21	Services (Basic)	$915,370
R413	Specifications Development Services	$18,246

PSC	PSC Descriptive Name	Contract Dollars (Thousands)
B504	Study/Chemical-Biological	$101,625
B506	Study/Data - Other Than Scientific	$70,059
B509	Study/Endangered Species-Plant/Animals	$11,269
B510	Study/Environmental Assessments	$151,023
B513	Study/Feasibility - Non-Construction	$51,083
B546	Study/Security (Physical & Personal	$24,730
R414	Systems Engineering Services	$2,617,802
L070	Tech Rep Services/ADP Equipment & Supplies	$24,961
R421	Technical Assistance	$1,018,213
D316	Telecommunication Network Mgmt Services	$272,834
5805	Telephone And Telegraph Equipment	$361,190
6645	Time Measuring Instruments	$6,319
3010	Torque Converters & Speed Changers	$37,924
	Total of Contract Amount	$45,911,612

Some PSCs are clearly spatial, others are not. Interoperability - like what GOS promotes by aligning federal spatial readiness purchasing around standards embodied in bulk procurement specifications - should result in greater competitiveness. One might expect interoperability to penetrate the market over time (i.e., FY 2000 – 2003), permitting greater competition for federal contracts and with that competition, more bang for the spatial readiness buck. Using clearly spatial PSCs, one can analyze whether federal markets are becoming more competitive.

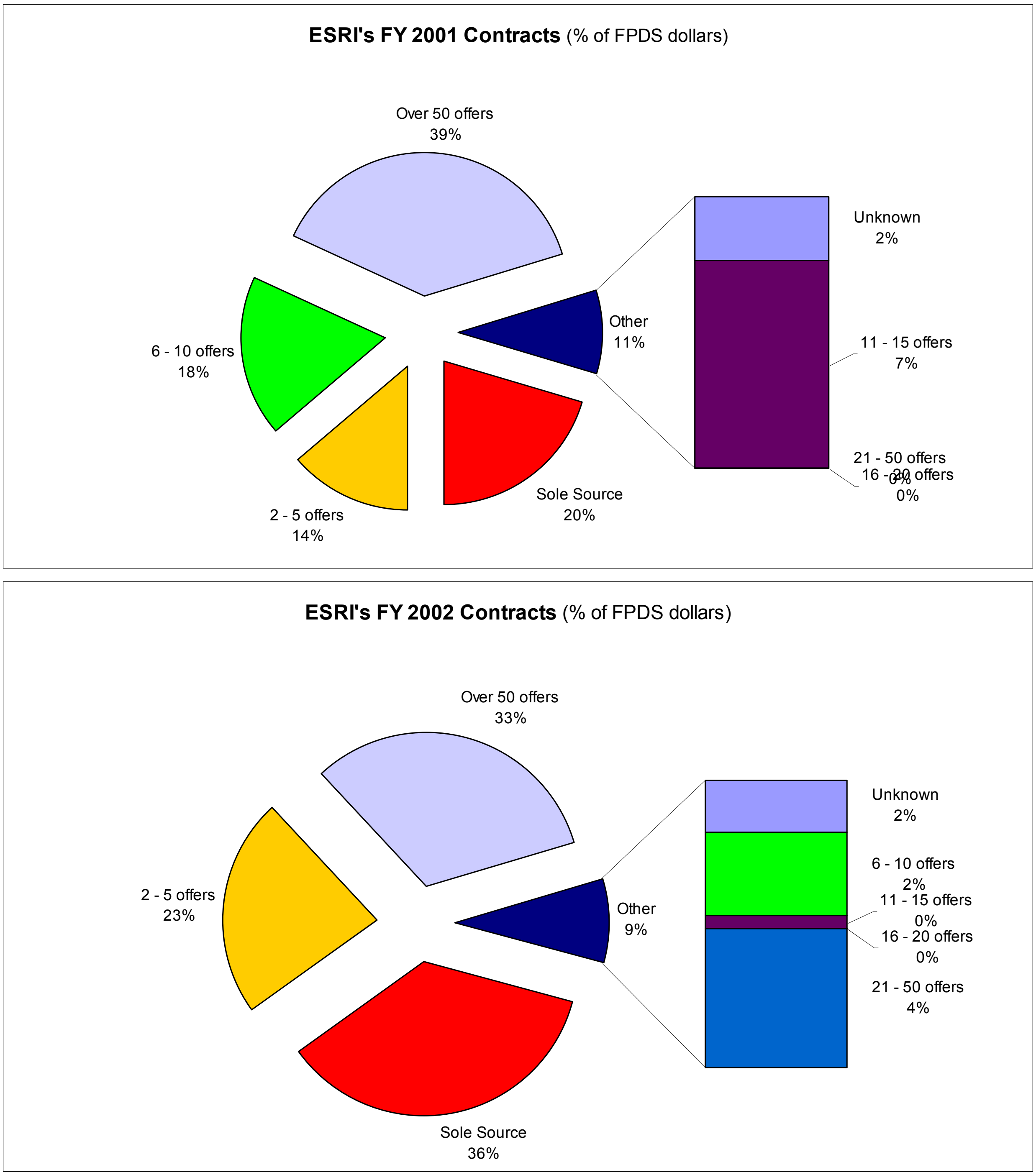
A year-by-year comparison illustrates how competitiveness can be shown using FPDS data. The following charts suggest[58] changes in how competitively two well-known software vendors, ESRI and Intergraph, bid for federal contracts. The one year jump in “sole source” procurements for ESRI (20% to 36%) and Intergraph (12% to 32%) suggests that these companies received an increasing share of their federal contracts without competition. Bulk purchasing, homeland security and other policy justifications may explain such shift. However, as in markets for other technologies, concentrated vendor dominance can stifle competition, and may lead to slower paced changes in interoperability amongst enterprise-wide spatial readiness investments. If GOS’ marketplace Module allows federal agencies to see their procurement justifications in light of trade-offs in promoting competitive, interoperable platforms and data purchases for meeting spatial intelligence needs across all enterprise functions (i.e., the FEA BRM

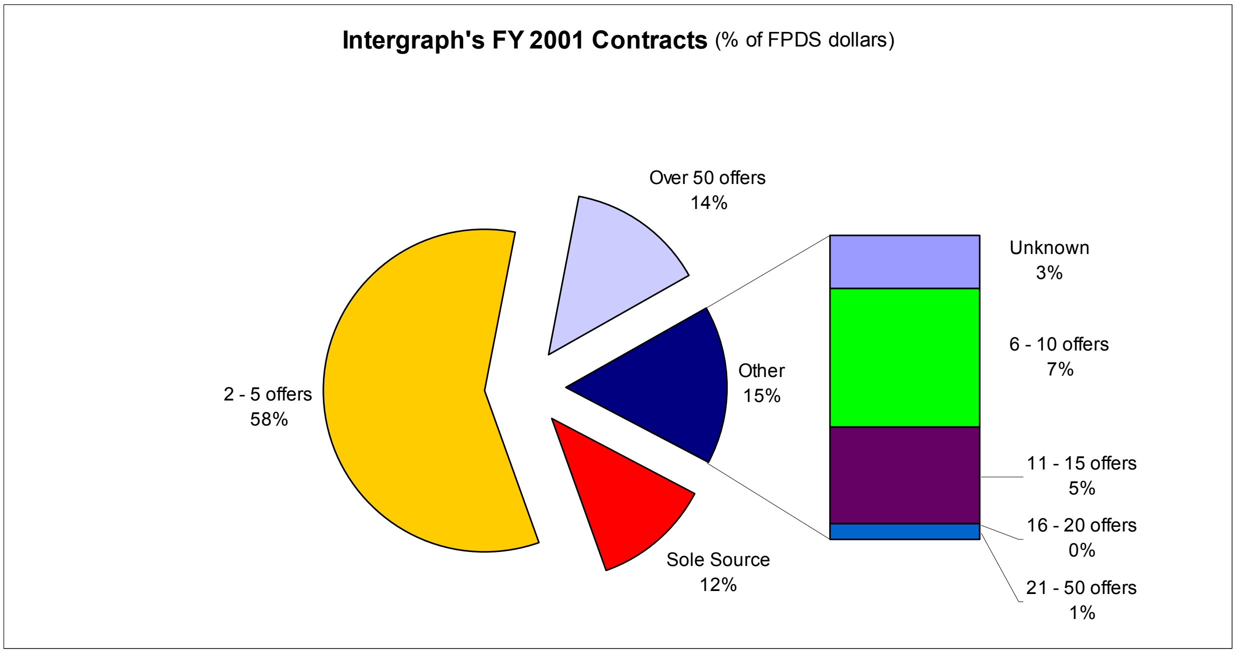
[58] A few caveats in using this charts are appropriate, including the following:

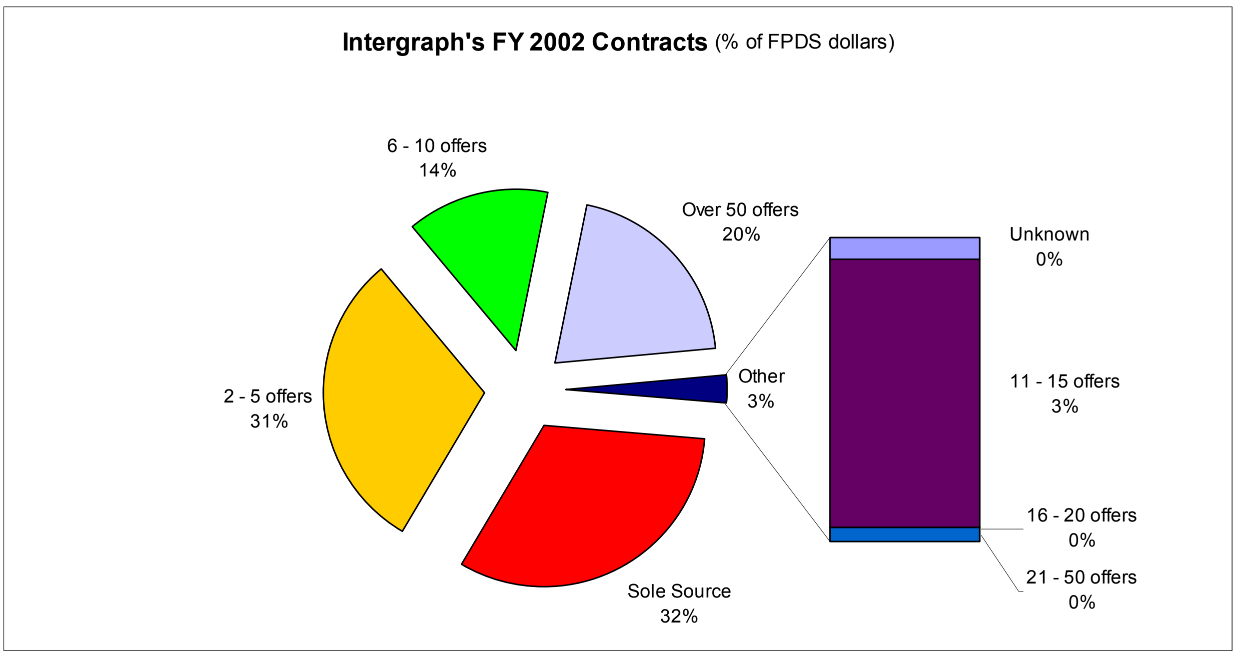
- the category of “sole source” may include negotiated procurements
- the charts use the more meaningful label of “sole source” to describe the FPDS’ category of “one bid received”
- FPDS data received from agencies may miscode procurement bidding
- the World Trade Center attacks on September 11, 2001, may explain part of the jump in use of sole source contracting for GIS software and services reflected in the charts

sub-functions), the improvements in making those trade-offs would tip for creating value attributable to GOS.

Figure 18 Illustrative FY 2001-2002 Competitiveness Charts using FPDS Data







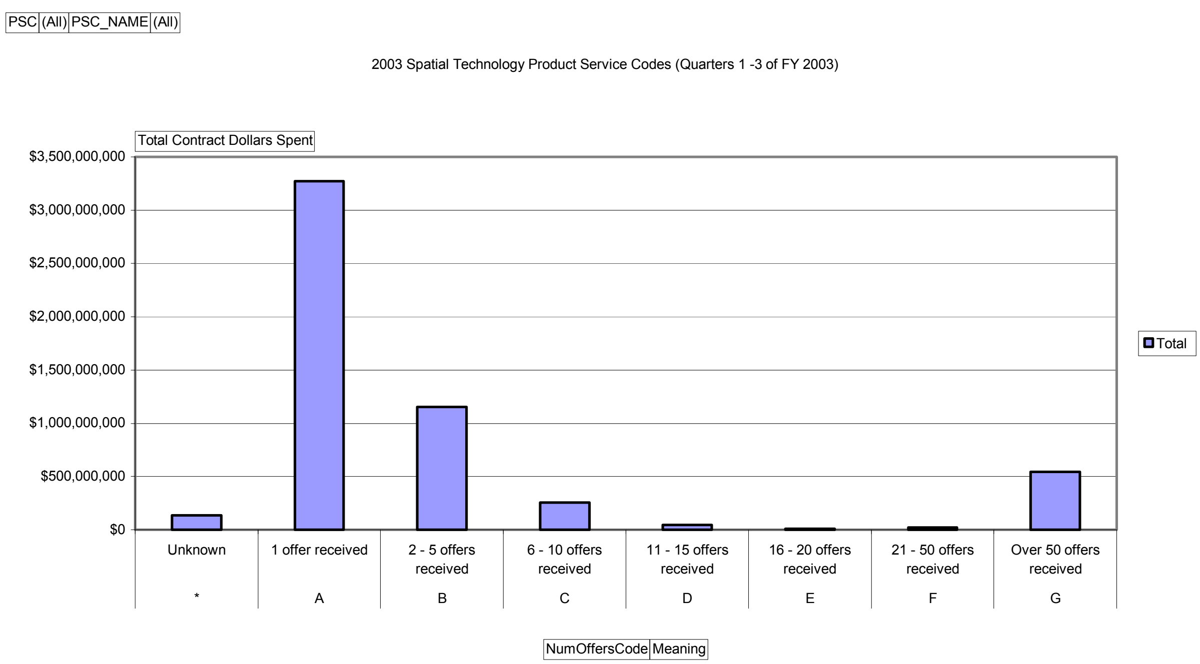
If GOS is right and spatial intelligence is a market basket of spatial readiness investments that could be better aligned, competitiveness across the entire basket of procurements is not high. Figure 19 charts the bids received during the first three quarters of FY 2003 for all PSCs historically used by over 1,500 spatial vendors to describe their product and service offerings.[59] Out of approximately $5.4 billion in procurements, approximately $3.3 billion – 60% - were coded as “one bid received” a/k/a sole sourced. However, the $5.4 billion is made up of dozens of PSCs, and the

59 Figure 19 is subject to the caveats mentioned in footnotes 56, 57 and 58.

portion of "one bid" procurements for each PSC is not 60%. Cartography Services (PSC T002) is very competitive, with less than 1% of the $870,676 being awarded as sole source. But cartography's $870,676 is only 0.16% of the $5.4 billion. PSC F999 for "Other Environmental Services, Studies & Support" represents $603.2 million, of which 23.6% was awarded as one-bid contracts.

Vendor concentration of federal buying for certain PSCs illustrates GOS' opportunity to help agencies make wiser federal spatial readiness investments. If GOS' portal helps agencies visualize, discuss and align their spatial readiness investments, the dominance of sole-source providers and pre-cut solutions should subside, with the likely emergence of *communities of practice* interested in taking advantage of *common operating pictures* for federal activities.

Figure 19 Illustrating Competitiveness for All PSCs used by Spatial Vendors



Chapter 14 **GOS' Effect on Gross Domestic Product (GDP)**

Some analogize the NSDI to the National Highway System, suggesting that national and regional productivity gains from spatial data's superhighway might be hard to measure but historically obvious. The NSDI which has been under development by federal agencies and their state, local, academic and industry partners for more than a decade. GOS will not – in and of itself – build the NSDI. However, GOS does supply political and budgetary leadership for NSDI development at the highest levels of commitment and accountability, and involves OMB actively in scrutinizing agency diversions and investments away from the confluence of a superhighway's infrastructure development program. If GOS does harness fiscal purchasing and investments across the federal government to the degree represented by the National Highway System, then GOS indeed may positively impact GDP.[60]

---

60 Heather Winnor, *The Truth on Spending: How the Federal and State Governments Measure Up (*Elon College *Issues in Political Economy* - July 2000), Volume 9, p. 11, http://www.elon.edu/ipe/winnor.pdf.

Chapter 15 **Concluding Thoughts**

The value of spatial data is its value in use, what the Report calls *spatial intelligence*.

This Report has highlighted various approaches – quantitative and qualitative –to portray the value of Geospatial One-Stop in allowing users to realize spatial intelligence through investments in people, systems and data generating spatial intelligence (*spatial readiness investments*). The Report proves the need for further quantitative research into the relationship between spatial readiness and government agency business processes.

GOS is one of a number of national initiatives to align federal investments in spatial readiness. Leadership is a powerful catalyst for management change. It can not be emphasized too strongly that – coupled with OMB budgetary guidance – GOS (along with state and regional I-Teams and other collaborations) have the potential to enable agencies to more consistently pursue, find and share resources to support a visible spatial intelligence strategy across the federal enterprise.

As this Report showed by using FPDS procurement data, better analytic tools to visualize federal technology requirements and procurements are worth developing so that spatial readiness activities can be aligned more rapidly by the marketplace. The minor annual cost of strategic investment efforts (like GOS) pales in comparison to their potential for alleviating federal data exchange bottlenecks that impact such serious business process applications as known gaps in homeland security datasets.

The unmet needs for state and local spatial readiness revealed by the PTI Study remain a compelling reason for improving the federal capacity to partner with sister governments by

- standardizing federal spatial data holdings using interoperable, open standards,
- discovering more easily previously undiscoverable or non-standardized datasets,
- providing technical resources or even financial resources and
- engendering interest in pooled procurements to reduce initial and annual maintenance costs.

Appendix A: A More Detailed View of the 1973 OMB Mapping Charting & Geodesy (MC&G) Report

Figure 20 Detailed View of 1973 MC&G Report's Findings

Column		A	B	C	D	E	F	
MC&G Report (page)		**Agencies Involved**	**Personnel (man years)**	**Expenditures (millions 1972 dollars)**	**Expenditures in millions 2004 dollars (where $1 1972 = $4.45 in 2004)**	**Plus: Increase in Civilian Federal Budget since 1972 (162.56%) in millions 2004 dollar**	**Plus: Increased Scale & Scope of Spatial Readiness Applications (assumed 15%) in millions 2004 dollars**	**Total 1972 Expenditures Projected into 2004 million dollars (Columns D, E & F)**
	Federal Activities in 1972							
1, 13	Total Activity	39	17,384	$446.81	$1,988.31	$3,232.20	$298.25	$5,518.75
13	**Land Surveys**							
14	Total Activity consisting of:	28	4,282	$74.90	$333.29	$541.80	$49.99	$925.08
17	National Geodetic Program (horizontal & vertical controls)	8	500	$9.10	$40.47	$65.79	$6.07	$112.34
36	Earth Physics (earth model, polar motion, crustal movement)	5	253	$7.35	$32.70	$53.15	$4.90	$90.76
41	Geophysical (gravity, magnetism, seismology)	7	142	$3.27	$14.56	$23.67	$2.18	$40.41
57	Mapping Control	7	524	$10.74	$47.78	$77.66	$7.17	$132.60
44	Cadastral (relating to 1 million square miles of public lands)	10	790	$14.12	$62.85	$102.16	$9.43	$174.44
56	Construction & Facility	17	2,073	$30.32	$134.94	$219.35	$20.24	$374.53

Column		A	B	C	D	E	F	
MC&G Report (page)		**Agencies Involved**	**Personnel (man years)**	**Expenditures (millions 1972 dollars)**	**Expenditures in millions 2004 dollars (where $1 1972 = $4.45 in 2004)**	**Plus: Increase in Civilian Federal Budget since 1972 (162.56%) in millions 2004 dollar**	**Plus: Increased Scale & Scope of Spatial Readiness Applications (assumed 15%) in millions 2004 dollars**	**Total 1972 Expenditures Projected into 2004 million dollars (Columns D, E & F)**
13	**Land Mapping & Aeronautical Charting**							
62	Total Activity consisting of:	28	5,844	$112.90	$502.38	$816.67	$75.36	$1,394.41
65	National Topo Maps	4	1,600	$36.30	$161.54	$262.59	$24.23	$448.36
85	Special Base Maps (planimetric maps, digitized map data, photo bases)	23		$21.50	$95.68	$155.53	$14.35	$265.56
93	Thematic & Other Maps including:			$38.60	$171.77	$279.23	$25.77	$476.76
93	Soil Maps	1	215	$3.60	$16.02	$26.04	$2.40	$44.47
94	Geologic & Hydrologic Maps		63	$2.30	$10.24	$16.64	$1.54	$28.41
96	Flood Insurance Maps			$2.00	$8.90	$14.47	$1.34	$24.70
98	Cadastral Maps	9	137	$4.60	$20.47	$33.28	$3.07	$56.82
99	Recreation Maps			$0.50	$2.23	$3.62	$0.33	$6.18
99	Local Project Maps	15	635	$17.00	$75.65	$122.98	$11.35	$209.97
100	Miscellaneous Maps			$8.60	$38.27	$62.21	$5.74	$106.22
101	Aeronautical Charting	3	822	$16.54	$73.60	$119.64	$11.04	$204.28

Column		A	B	C	D	E	F	
MC&G Report (page)		**Agencies Involved**	**Personnel (man years)**	**Expenditures (millions 1972 dollars)**	**Expenditures in millions 2004 dollars (where $1 1972 = $4.45 in 2004)**	**Plus: Increase in Civilian Federal Budget since 1972 (162.56%) in millions 2004 dollar**	**Plus: Increased Scale & Scope of Spatial Readiness Applications (assumed 15%) in millions 2004 dollars**	**Total 1972 Expenditures Projected into 2004 million dollars (Columns D, E & F)**
	Marine Mapping, Charting & Related Surveys							
109	Total Activity consisting of:	17	5,371	$219.56	$977.04	$1,588.28	$146.56	$2,711.88
111	Systematic Mapping & Charting, consiting of:							
111	Nautical Charting	5	1,196	$22.57	$100.43	$163.26	$15.06	$278.76
111	Bathymetric Mapping	3	484	$16.06	$71.44	$116.14	$10.72	$198.30
111	Geophysical/Geological Mapping	4	113	$11.76	$52.35	$85.09	$7.85	$145.29
111	Scientific & Engineering Surveys, consisting of:							
111	Hydrographic Surveys	4	446	$7.47	$33.23	$54.02	$4.98	$92.23
111	Bathymetric Surveys	1	84	$11.87	$52.80	$85.83	$7.92	$146.55
111	Geophysical Surveys	8	499	$47.25	$210.26	$341.80	$31.54	$583.60
111	Platform-Related Oceanographic Survey Activity	6	2,549	$102.59	$456.53	$742.13	$68.48	$1,267.13
	Technical Services							
	Total Activity consisting of:			$92.20	$410.29	$666.97	$61.54	$1,138.80
133	Imagery Collection & Processing	7		$6.50	$28.93	$47.02	$4.34	$80.28
141	Photogrammetric Processing	14	1,105	$18.00	$80.10	$130.21	$12.02	$222.33
147	Cartography	18	2,500	$37.50	$166.88	$271.27	$25.03	$463.18
150	Printing & Distribution	18	263	$9.50	$42.28	$68.72	$6.34	$117.34
154	Data & Informaiton Systems	19		$9.60	$42.72	$69.45	$6.41	$118.57

Column		A	B	C	D	E	F	
MC&G Report (page)		**Agencies Involved**	**Personnel (man years)**	**Expenditures (millions 1972 dollars)**	**Expenditures in millions 2004 dollars (where $1 1972 = $4.45 in 2004)**	**Plus: Increase in Civilian Federal Budget since 1972 (162.56%) in millions 2004 dollar**	**Plus: Increased Scale & Scope of Spatial Readiness Applications (assumed 15%) in millions 2004 dollars**	**Total 1972 Expenditures Projected into 2004 million dollars (Columns D, E & F)**
162	Research & Development	10	440	$11.10	$49.40	$80.30	$7.41	$137.10

Notes to Appendix A:

Source: OMB, *Report of the Federal Mapping Task Force on Mapping, Charting, Geodesy and Surveying* (1972)
1972 dollars inflated to 2004 dollars at $4.45 in 2004 per $1 in 1972, the rate given by the the rate given by Bureau of Labor Statistics Inflation Calculator, http://data.bls.gov/cgi-bin/cpicalc.pl
Totals may reflect rounding, grouping and other conventions used in 1973 Report.