APPENDIX B
LITERATURE REVIEW

1. Ayan, Danielle. 2003. Compiling a Business Case for a State GIS Clearinghouse. ESRI Education User Conference 2003.

Summary

The Georgia Tech Center for GIS compiled the Business Plan Business Case for the Georgia Geographic Information Systems Coordinating Committee (GISCC). The intent of the business case is to economically justify the existence of the GISCC and the State Data Clearinghouse it oversees. Because Clearinghouse benefits are mostly intangible—i.e., increasing data accuracies—and because literature regarding Clearinghouse valuation approaches is scarce, it is difficult to perform a proper cost analysis supporting the GISCC and Clearinghouse. The resulting business case, however, quantifies benefits wherever possible and delivers a strong message of the benefits to cost advantage.

Excerpts

"On average, the Clearinghouse daily Internet data download is 1.7 Gb and 750 Mb from other means of data dissemination. The user base grows by an average of 366 members per month (based on 2002 statistics). These statistics alone reveal public dependency on the State Clearinghouse and justify its existence."

"A case-in-point of a current GIS application benefiting multiple stakeholders (state and local governments and private industry) financially and efficiently is the timber industry and Georgia Department of Revenue's Property Tax Division's joint Timber Assessment Satellite Imagery Project. The project consolidates many different datasets into an easy-to-use application for the identification of land cover changes. The data includes Georgia Department of Transportation road network coverage, 1993 Georgia DOQQs, digital topographical maps, and two years of satellite imagery. By comparing ground cover change detection derived from satellite imagery analysis, a GIS application has been created to delineate areas of timber harvest. This program is distributed to all Georgia counties via CD-rom. Harvested areas are displayed graphically atop DOQQs allowing tax assessor staff to cross-reference property owners with timber taxes paid or unpaid. Although incentives and penalties encourage harvesters to pay timber taxes, it can be estimated that counties only collect approximately 75% of due timber taxes. The DOR Satellite Imagery Project application allows Georgia counties to properly assess harvested acreage.

"… five key areas of impact that the Clearinghouse will implement with continued commitment.

> 1. Expedited service: electronic data download via FTP (including large datasets, such as imagery)

2. Additional datasets: Clearinghouse will encourage fresh data contributions via state and local agency inventories.

3. Integration with Georgia.gov: Clearinghouse Web site will be revamped to include dynamic content, easier access to data, and easier navigability. Pending Georgia Technology Authority approval, it will be integrated with Georgia.gov as a Sub-portal site complying with state requirements and support.

4. Better cost-recovery: for-fee data (i.e., imagery) will be more accurately priced and will have more added value, i.e., new products will be built atop the standard DOQQ, such as MrSid files, .jpg files, etc.

5. E-commerce functionality: Clearinghouse purchases will be improved, and data will be streamed via the Internet thereby expediting customer receipt and greatly reducing clearinghouse time and materials."

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2. Xirgu, Dani. 2003. Generating Metadata: Saving Money in the Organizations. *9th EC GI & GIS Workshop, ESDI Serving the User, A Coruña, Spain, 25-27 June 2003.*

Summary

This study examines how to quantify the final costs and benefits in the process of geographic metadata creation. The study is focused on the personnel involved in the process: hours invested, directly or indirectly, and salaries. Also, it considers the personnel training concerning the program and the metadata standard.

Excerpts

The metadata must contribute to the value of the geographic data. It must "increase the exchange information and the economic transactions of the spatial information producing companies. …many companies show certain distrust in concepts like interoperability, interchange, metadata... whether for excessive secrecy … This study has tried to demonstrate … that the cost of the metadata creation is not excessively high and, in addition, it's easily recoverable…." Metadata should be viewed as an investment that will produce benefits.

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3. MetroGIS Staff. December 2004. Performance Measurement *Report for the period October 1, 2003 through September 30, 2004. Report was prepared by MetroGIS Staff, accepted by the*

MetroGIS Coordinating Committee on December 15, 2004, and approved by the MetroGIS Policy Board on January 26, 2005.

Background

In early 2002, MetroGIS developed a Performance Measurement Plan to more clearly state expected accomplishments, to demonstrate accountability for results, and to support continuous organizational improvement. MetroGIS's mission is to provide an ongoing, stakeholder-governed, and metrowide mechanism through which participants easily and equitably share geographically referenced graphic and associated attribute data that are accurate, current, secure, of common benefit, and readily usable.

Report Contents

The report reviews Performance Measures (PM) for MetroGIS as follows:

A. Outcomes for Data Users – Ease-of-discovery and access

PM #1: Visitor sessions to DataFinder web site

PM #2: Datasets downloaded through DataFinder

PM #3: Sector/stakeholder groups

PM #4: Datasets and metadata records on Data Finder

B. Outcomes related to Users – Data Currency

PM #5: Percent of Datasets Updated

C. Outcomes related to Producers – Internal efficiencies; level of cooperation

PM #6: Manual vs. self-service requests for data (by producer type)

PM #7: Staff time saved in data distribution tasks (by producer type)

PM #8: Entities listing metadata records on DataFinder

PM #9: Entities using DataFinder and DataFinder Cafe as a data distribution method

D. Ultimate Outcomes – Improved decision-making and better service to the public

PM # 10: Testimonials (Non-quantitative)

4. Pluijmers, Yvette. 2002. The Economic Impacts of Open Access Policies for Public Sector Spatial Information. *Presented at FIG XXII International Congress, Washington, D.C., USA, April 19-26 2002.*

Summary

Governments around the world are the largest producers of spatial information. Public sector spatial information is a major, but so far under-exploited asset, which could and should be a fundamental building block of the new economy and the information society.

United States federal information policy is based on the premise that government information is a valuable national resource and that the economic benefits to society are maximized when government information is available to all. However, other governments do not necessarily share this view and are sometimes treating their information as a commodity to be commercialized. Arguments to support open access policies have primarily focused on the fact that the information has already been paid for by taxpayers who should not be charged a second time for it. Although these arguments are convincing to many, they are not yet strong enough to convince all governments to abandon short-sighted attempts to raise relatively small sums of immediate revenue in favor of adopting policies which maximize economic benefit—particularly jobs and wealth—encourage scientific and technological research and development, and ultimately maximize general tax revenues in the longer term. This paper provides an economic argument to go towards open access policies. Based on the specific economic characteristics of spatial information and both qualitative and quantitative research on economic effects it is argued that open access policies are beneficial in the short term as well as in the longer term for the general public, the private sector, and also for government entities.

Excerpts

"The consensus of recent research is that charging marginal cost of dissemination for public sector information will lead to optimal economic growth in society and will far outweigh the immediate perceived benefits of aggressive cost recovery. Open government information policies foster significant, but not easily quantifiable, economic benefits to society."

"High prices for information ultimately lead to predatory and anticompetitive practices, like price dumping, and the creation of government owned corporations or joint ventures with preferred private sector entities that may serve to exclude others from the market."

"Some government agencies are willing to liberalize their policies, but fear they will suffer budget consequences … open data policies will create wealth and tax revenues more than adequate to offset the short term losses and to fully fund agency information activities ... open access to government information is critical to the information society, environmental protection, and economic growth."

5. Booz Allen Hamilton. January 2002. *XML.gov Registry/Repository Business Case*

Summary

The purpose of this business case analysis (BCA) is to provide the justification for the XML.gov Registry/Repository, based on an analysis of its cost, value, and risk. The primary business driver for the BCA is to address the need for the coordination and interoperability of Extensible Markup Language (XML) registry/repositories sponsored by federal agencies.

This XML.gov Registry/Repository BCA was prepared using the Value Measuring Methodology (VMM). VMM provides a structure in which a broader range of benefits than those considered in a traditional cost-benefit analysis are captured and quantified. This approach is compliant with guidance from the Office of Management and Budget (OMB) and incorporates both public and private sector analytical best practices.

Accordingly, this business case documents the analysis and comparison of the costs, value (benefits), and risks of initiative alternatives analyzed using VMM.

Excerpts

"The eXtensible Markup Language (XML) has emerged as a key technology to assist commercial and government organizations in exchanging information and conducting business over the Internet. Groups of public and private organizations are using XML today to define standard data components and business processes that can be built into Web applications, enabling them to use the Internet in innovative ways. As communities of interest define XML elements to be used in their business transactions, other business partners seeking to implement XML solutions—either within these particular communities or for their own internal use—can access the results of these standardization efforts. These XML definitions can be published via XML registries, which are data stores created according to industry standards to facilitate the sharing and reuse of XML artifacts. Several such registries have been and are currently being established by agencies of the federal government to support the use of XML technology in IT projects."

"The current federal XML environment is characterized by a patchwork of initiatives with varying goals. There is no common definition of what a government-sponsored XML registry or repository should contain. … Once implemented, the XML.gov Registry/Repository initiative will enable suppliers of goods, services and IT to share information seamlessly with their government customers. Both application owners (AOs) in agencies and their user communities will benefit from the transactional, technological, and communications efficiencies that a coordinated Federal XML effort would deliver."

6. Montgomery County, Maryland. 1999. Geographic Information System Cost/Benefit Assessment Report M-NCPPC. *Submitted to: Montgomery County Council's Management and Fiscal Policy Committee April 12, 1999.*

Abstract

A "Benefit Assessment Report" was prepared in November 1997. This 1999 report was prepared by using the original report's format. The information has been updated and expanded to reflect the benefits. M-NCPPC has traditionally performed a variety of map and geographic analysis functions. A standard set of property maps has been maintained and updated for years. GIS implementation began in 1989, following the preparation of a feasibility study and a implementation plan. A pilot project was conducted in coordination with Montgomery and Prince George's County Executives and WSSC. Large-scale map database development began in 1992 following an evaluation of the pilot project. The basemap development was completed, on schedule, in July 1997.

Currently, the GIS has been implemented and is operational throughout the county. Many departments and agencies are now using GIS to support their functional operations. MNCPPC is performing maintenance on the basemaps and developing additional coverage, such as the street address and zoning. The property coverage is updated daily, and a maintenance plan has been developed for the planimetric/topographic coverage.

Excerpts

"The ability to analyze and compare areas in the County, with uniform data, provides a decision-making tool, which was almost impossible before the GIS."

"…it could take weeks or months to produce a certain map, while with the GIS not only is it faster, but different options can now be tried with the saving of preparation time."

"The maps produced in this group are all special types of maps that would have been quite difficult (i.e., legislative district) or impossible (the conference maps) to produce without GIS."

"M-NCPPC is just beginning to realize that the savings/benefits of the GIS are not only quite varied, but can also be unexpected. Some of these benefits were anticipated while others are a pleasant surprise. One such surprise is the saving of file space and work hours needed to file copies of the basemaps. Now that current copies of the basemaps are readily accessible, maintaining a file of the maps is unnecessary. This frees staff up to do other tasks, but also frees up floor space in an already crowded building."

7. Fries, T. James, Annie Metcalf, and Dr. Lisa Warnecke. 2001. Final Best Practices Report for the Ohio Spatial Data Cost-Benefit Analysis. *Prepared for: Stuart R. Davis Ohio State Project Manager and Executive Director Ohio Geographically Referenced Information Program.*

Summary

This report provides a summary of information from 15 selected states. The focus is on statewide geographic information and related technology (GI/GIT); including funding sources to support statewide data development, management, and maintenance; and approaches supporting a more comprehensive approach to statewide data management

The primary focus is on funding sources:

- Dedicated Funds
- Mission-driven Funding
- Assessments on Agencies
- Central and Capital Funding
- Cost Recovery

The advantages and disadvantages of these funding sources are discussed.

Excerpts

"Approaches to funding state spatial data development and coordination vary significantly. However, one point that was very clear was the use of multiple funding sources by the majority of states to support their efforts. The majority of states have a primary funding source augmented with several other secondary sources in support of spatial data development and coordination."

"These 15 states and many others have successful programs because they have a maintained, stable, and reliable funding level. This has been key to the development of their spatial data management and GIS coordination programs."

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8. McInnis, Logan and Stuart Blundell. 1998. Analysis of Geographic Information Systems Implementations in State and County Governments of Montana. *Prepared for: The Montana Geographic Information Council, October 1998.*

Summary

The Montana Geographic Information Council perceived a need for an economic analysis of geographic information system (GIS) implementations at the state and county government levels. This study was commissioned for the dual purpose of determining the monetary benefits for justification of GIS implementation and devising a set of guidelines for planning future GIS implementations at the state and local government levels.

The Gillespie regression model was used to measure economic benefits for a number of case studies of GIS implementation by state and local government agencies in Montana. Economic benefits were estimated from key GIS applications utilized by each agency included in the case study. The costs and benefits of GIS revealed some important benefits of using the model. First, the model allows effectiveness benefits to be estimated in a straightforward manner. In addition, the model deals with GIS on an application-by-application basis.

Excerpts

"GIS implementation should focus first on applications, not data"

"The primary focus of our study was to identify benefit/cost analysis methods and apply them to a number of case studies … The nine case studies described in Section 3 provide excellent examples on how to apply the Gillespie model …"

"The other goal of the study was to summarize the lessons agencies have learned thus far in their efforts to implement GIS. If there was one question that was easy for the interviewees to answer, it was the question about the lessons they have learned. Every person we talked to was certain about what things had caused the greatest problems. GIS implementation does not happen smoothly without a great deal of planning and coordination. If this report can save other agencies from experiencing some of these same difficulties, then it has achieved its second goal as well."

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9. Thomas, Christopher and Milton Ospina, Editors. 2004. *Measuring up the Business Case for GIS. ESRI Press.*

Description

This book offers case studies about companies and government agencies that have implemented GIS solutions to meet business goals and how their successes with this technology measure up in:

- Saving money and time
- Increasing efficiency, accuracy, productivity, communication and collaboration

- Generating revenue
- Supporting decision-making
- Aiding budget development
- Building information bases
- Managing resources

It presents 75 articles from 22 business sectors. The book describes not only what people are doing with GIS, but how these new business processes have improved communities and organizations.

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10. Koontz, Linda D. 2003. Geographic Information Systems Challenges to Effective Data Sharing. *GAO-03-874T, Testimony before the Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census, Committee on Government Reform, House of Representatives.*

Excerpts

"The federal government has tried to reduce duplicative geospatial data collection by coordinating GIS activities within and outside the federal government. For example, in 1990, the Office of Management and Budget established the Federal Geographic Data Committee to promote the coordinated use, sharing, and dissemination of geospatial data nationwide. In 1994, the National Spatial Data Infrastructure (NSDI) program was established by executive order to address the problem of the redundancy and incompatibility of geospatial information on a national basis. More recently, Geospatial One-Stop, a component of NSDI, was initiated."

"Federal, state, and local government agencies are using GIS today to provide vital services to their customers. For example, local fire departments can use geographic information systems to determine the quickest and most efficient route from a firehouse to a specific location, taking into account changing traffic patterns that occur at various times of day. Highway departments use GIS to identify intersections that have had a significant number of personal injury accidents to determine needs for improved traffic signaling or signage. GIS can also be an invaluable tool in ensuring homeland security by facilitating preparedness, prevention, detection, and recovery and response to terrorist attacks."

"Developing common geospatial standards to support vital public services has proven to be a complex and time-consuming effort. The number of types of geospatial data and the complexity of those data make developing geospatial standards a daunting task."

"In summary, a coordinated nationwide network of geographic information systems offers many opportunities to better serve the public, make government more efficient and effective, and reduce costs."

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11. SAIC, 2001. Final Report: Requirements and Cost Benefit Analysis Managing Geospatial Data for Better Program Delivery a Service Center Initiative. *Prepared for United States Department of Agriculture Natural Resources Conservation Service Beltsville, Maryland.*

Summary

The focus of this study is the three Service Center Agencies of the United States Department of Agriculture (USDA):

- Natural Resources Conservation Service (NRCS) and Conservation District (CD) partners
- Farm Services Agency (FSA)
- Rural Development Agencies (RD)

The three Service Center Agencies share a common high-level mission to enhance the quality of life for the American people by supporting agricultural production while upholding a healthy and productive nation in harmony with the land. Although the mission is the same, the individual business requirements vary from one agency to another.

The tasks for this study were:

- Review and validation of the business requirements of the three Service Center Agencies and partners.
- Identification of emerging technologies that will affect geographic information systems (GIS) in the next 5 to 10 years.
- Development of potential geospatial information architectures (GIA) for the three Service Center Agencies and partners.
- Estimation of benefits, life-cycle costs, and other financial metrics for potential GIAs.
- Development of recommendations regarding GIAs that are balanced among the technological, cost-benefit and cultural/political realities of the organizations.

Excerpts

"The CBA results support the investment in GIS for all three alternatives. However, the case is much stronger for the to-be distributed and to-be mixed alternatives."

" In this analysis, all three had a positive NPV."

"GIS provides several benefits that accrue to both the USDA and its customers but are difficult to assess quantitatively. Following is a list of some of the qualitative benefits of GIS:

- Ability to use geospatial information to make informed business decisions.
- Faster access to more current and accurate geospatial information.
- Improved map quality and access to a common base map.
- Elimination of redundant work and data, resulting in reduced Service Center workload.
- Accurate data development.
- Efficient analysis tool.
- User-friendly querying techniques"

"The as-is alternative is not an acceptable solution. It supports only 25% of the business requirements. It also has a negative cost-benefit relationship as it costs about $60 million more than it returns and it has a number of technical weaknesses."

"The table below summarizes the financial, technical and organizational rankings of the three "to-be" alternatives. The To-Be Centralized Alternative is consistently the third choice. The To-Be Distributed Alternative is clearly the best choice financially and organizationally. It ranks second technically as it does not support all of the business requirements and has a worse ratio of pros to cons than the To-Be Mixed Alternative. However, its financial results, the organizational realities and its strong showing in the technical areas make the To-Be Distributed Alternative the recommended choice."

	Net Present Value Risk Adjusted	**Benefit Cost Ratio**	**Internal Rate of Return**	**Payback Year**	**Pros and Cons**	**Requirements Supported**	**Organizational Solution**	**Recommended Solution**
To-Be Distributed Alternative	$596 M Best	1.97 Best	86% Best	2004 Best	6 to 3 Second	85% Second	Best	Best
To Be Centralized Alternative	$18 M Third	1.02 Third	6% Third	2010 Third	4 to 6 Third	80% Third	Third	Third
To-Be Mixed Alternative	$361 M Second	1.35 Second	49% Second	2005 Second	9 to 2 Best	100% Best	Second	Second

12. Cahan, Bruce. 2004. The Value Proposition for Geospatial One-Stop. *A Report Prepared by Urban Logic, Inc. for the Federal Geographic Data Committee.*

Summary

Geospatial One-Stop (GOS) is one of 24 e-government initiatives of President Bush, within the cluster aimed at improving government-to-government operations. 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). This report investigates the value of GOS using different approaches.

Excerpts

"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."

"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."

"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."

"While some of the numbers are known or their magnitude can be inferred, no one has an accurate catalogue of spatial readiness investments."

"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."

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13. Price Waterhouse, 1995. *Australian Land and Geographic Data Infrastructure Benefits Study. for the Australia New Zealand Land Information Council.*

Summary

Land and geographic data indicate the location and nature of many of the inputs required for economic, social, and environmental development. They are a fundamental ingredient for major investment decisions and cover areas that include topography, property ownership, natural resource distribution, land use and administrative boundaries.

Recent studies point consistently to significant and broad ranging economic benefits from data usage. However, very little information exists on how substantial these gains might be for Australia as a whole. Previous studies have been narrowly based in terms of product, geographic or institutional coverage, and their results are difficult to aggregate.

As a first step towards bridging this information gap, the Australia New Zealand Land Information Council (ANZLIC) has commissioned the Economic Studies and Strategies Unit of Price Waterhouse to more closely examine the economic gains from developing, maintaining, improving and providing access to land and geographic data infrastructure at a national level.

Excerpts

"Extensive surveys conducted as part of the review revealed a benefit:cost ratio for data usage of approximately 4:1. This indicates that for every dollar invested in producing land and geographic data, $4 of benefit was generated within the economy. For the period 1989-94, these benefits were in the order of $4.5 billion."

"Over the past five years alone, established infrastructure has saved users over $5 billion, much of which was re-invested to generate additional economic activity. The results suggest that investment in

infrastructure of close to $1 billion since 1989 has been utilized effectively by data supplying agencies and has led to important cost savings for industry."

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14. Halsing, David, Kevin Theissen, and Richard Bernknopf. 1994. *A Cost-Benefit Analysis of The National Map. Circular 1271 U.S. Geological Survey.*

Abstract

In 2003, the USGS Geography Discipline conducted a cost-benefit analysis of its new program, *The National Map*. The analysis team simulated the benefits to society from increased use of the improved digital spatial data provided by *The National Map* and weighed those benefits against the cost to develop and implement it. Several different reports and articles describe the research, modeling, and results of this cost-benefit analysis project.

Results from the "most likely" estimates of model parameters and data inputs indicate that, over its 30-year projected lifespan, *The National Map* will bring a net present value (NPV) of benefits of $2.05 billion in 2001 dollars. The average time until the initial investments (the break-even period) are recovered is 14 years.

Excerpts

"Quantifying the full benefits of a GIS is a difficult task. Although it can be relatively straightforward to calculate some of the efficiency benefits directly, effectiveness benefits are very difficult to estimate and require a more rigorous analysis than is found in a traditional cost benefit analysis (Dickinson and Calkins, 1988; Gillespie, 2000). Accordingly, some of the economic evaluations of GIS in the literature make a quantitative estimate of the efficiency benefits that a GIS can potentially bring to an organization. However, only a few studies have made quantitative estimates of any of the effectiveness benefits (see for example, Bernknopf and others, 1993; McInnis and Blundell, 1998), and we are aware of no comprehensive study of the effectiveness benefits that GIS brings to an organization. Instead, effectiveness benefits are typically treated as an important, qualitative bonus that can be added to the more easily quantified cost-savings resulting from the implementation of a GIS (see for example, Hardwick and Fox, 1999)."

"Because of these limitations, as well as the time and resources available to conduct the analysis, a full accounting of the likely costs and benefits of *The National Map* was not feasible. Instead, we developed a computational simulation model called NB-Sim into which the best estimates could be entered. The model simulates ranges of results that can be expected from each set of inputs. It allows rapid adjustment of the inputs so that more pessimistic or more optimistic beliefs can be simulated, and so that new results can be generated if more input data or evidence becomes available."

"Because the benefits of *The National Map* are based on expected improvements in processing information for applications of spatial data, the willingness to pay for the program is based on its utility as a provider of that data. The value-added of *The National Map* originates from improvements in projected implementation time, reduced development and maintenance costs, faster rates of data inclusion and integration, and increased expected usage levels over time for geospatial applications. This is a derived demand for the online distributed database of *The National Map* and assumes that data are current, integrated, consistent, complete, and more accessible to produce the desired outcome of an application."

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15. Booz Allen Hamilton, 2005. *Geospatial Interoperability Return on Investment Study. Prepared for National Aeronautics and Space Administration, Geospatial Interoperability Office.*

Summary

This study examined two government applications of geospatial technologies: one project utilizing a high degree of open geo-interoperable standards and another project implementing none or few of these standards. The purpose of this study is to measure, both qualitatively and quantitatively, the return on investment (ROI) to organizations implementing geospatial standards, standards specifically developed to promote interoperability between a wide variety of different applications.

Geospatial interoperability is the ability for two different software systems to interact with geospatial information. Interoperability between heterogeneous computer systems is essential to providing geospatial data, maps, cartographic, and decision-support services, and analytical functions. Geospatial interoperability is dependent on voluntary, consensus-based standards, as set forth in OMB Circular A-119. These *geospatial standards* are essential to advancing data access and collaborations in e-Government, natural hazards, weather and climate, exploration, and global earth observation.

Excerpts

"Of the projects considered for this study, the project that adopted and implemented geospatial interoperability standards had a risk-adjusted ROI of 119.0%. This ROI is a "savings to investment" ratio. This can be interpreted as for every $1 spent on investment, $1.19 is saved on operations and maintenance costs."

"Overall, the project that adopted and implemented geospatial interoperability standards saved 26.2% compared to the project that relied upon a proprietary standard. One way to interpret this result is that for every $4 spent on projects based on proprietary platforms, the same value could be achieved with $3 if the project were based on open standards."

"Standards lower transaction costs for sharing geospatial data when semantic agreement can be reached between parties. The cost of achieving semantic agreement can be high, especially for data models. This

cost is reflected in the higher implementation costs for Case Study 1. However, these costs are more than recouped in lower operations and maintenance (O&M) costs. In this study, risk-adjusted costs for Case Study 1 was 30.3% lower than those for Case Study 2."

"The results of this study suggest that projects that adopt and implement standards early on in the project life cycle build in a margin of business resilience and operational flexibility that can lower long-term costs for operations and maintenance. Case Study 1 demonstrates that even when standards are immature, developing and implementing a minimal standard confers some benefits ... governments at different levels have varying motivations for adopting standards, and the standards they adopt vary widely. Federal government agencies are more likely to adopt and implement the ISO 19100-series standards and OGC specifications. But, county and municipal governments are more likely to develop and adopt local standards specifically for data exchange."

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16. Pelsoci, Thomas M. 2005. *End-User Benefits of The National Map and Geospatial-One-Stop: Benefits from Data Production, Data Sharing, and Data Distribution.*

Summary

A pilot study identified expected end-user benefits from *The National Map (TNM)* and Geospatial-One-Stop (GOS). Over a hundred municipal, county, and state agencies and associations of governments were contacted and structured interviews were conducted with 78 end-users in 36 states, covering metropolitan, urban, and rural areas.

Findings indicate that both the blanket and quilt layers of *The National Map*, i.e., the base-map component and the patchwork component of locally produced, federally integrated, high-resolution data will generate end-user benefits. The principal value appears to be the 'patchwork' component leading to efficiency benefits or cost savings as well as to effectiveness benefits through improved decision-making.

Excerpts

"Data distribution benefits result from avoided data publishing costs from using TNM and GOS portals. Often cited at municipal and state agencies, significant labor costs could be saved if local information were uploaded to a reliable, federally maintained, interactive Web site. Estimated savings range from $1,000 to $10,000 per agency per year. In addition, agencies can also avoid one-time systems investments and recurring software maintenance costs."

"Many local and state agencies incur significant customer service costs, responding to inquiries and maintaining Web sites for the distribution of local geospatial data. If local data could be published to a reliable and trusted, federally maintained, interactive Web site, i.e., *The National Map* and could also be referenced in Geospatial One-Stop, customer service savings could be realized from avoided labor costs and Web site costs, including one-time setup costs and recurring software maintenance costs."