

Economic Studies for GIS Operations



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State and local agencies constantly struggle to fund the enterprise GIS efforts that improve the efficiency and effectiveness of government. Given the competition for already scarce funding, some jurisdictions have begun to sell their GIS data and services. These decisions are often counter-productive and stifle innovation in the private sector which ultimately reduces the tax base.

It's unlikely that elected officials will fund the development of GIS data and systems without clear proof that the investments are being wisely made. This document was created by NSGIC's Data Sharing Work Group. It provides an introduction to economic studies and how they can help you make a convincing argument for funding.

<http://www.nsgic.org>

Overview

Systematic and well-accepted economic studies provide a clear rationale for ongoing budgetary support of geospatial operations without charging for public geospatial data above the direct cost of duplication.

Those familiar with geospatial technologies understand the following:

- GIS substantially improves how we apply our resources in business, education, recreation, and other fields.
- Government resources are limited and geospatial operations compete with higher profile programs for investments. Not every good idea will be funded.
- The value of geospatial data is proportional to the number of users and the actual work performed.
- GIS programs capable of supporting public decision-making are expensive to establish and maintain.

In spite of the inherent value of GIS, most entities that are starting or expanding GIS operations need to rationalize the expenses. But how does one do this?

GIS incorporates distributed information from many sources. The demand for GIS data and applications will typically extend beyond the primary design audience. It is, therefore, difficult to accurately determine the benefits of the collective investment to the extended community.



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Determining the return on investment and other benefits accrued from geospatial operations will help to ensure their sustainability and promote geospatial data sharing. This paper provides a fundamental description of economic studies.

Definitions and Notes

Geospatial Data – Geospatial data identify the geographic location of features and boundaries and include descriptive information about the character and content of the features. The data are mapped, manipulated, and analyzed using Geographic Information System (GIS) software applications.

Geographic Information System (GIS) – A software system designed to capture, store, manipulate, analyze, manage, and present geographical data. GIS merges cartography, statistical analysis, disparate databases, and computer science technology.

Geospatial Operations – Geospatial Operations are those ongoing and recurring activities involving the collection, maintenance, and analysis of geospatial data using GIS software for the purpose of improving the knowledge and efficiency of an organization.

Studies that made a difference

1 - Montgomery County, Maryland

This study considered the increased revenues enabled by usage of GIS application in Montgomery County and determined the following:

- Investment in analysis and local updates of Census addresses (LUCA) using GIS delivered almost 40,000 new addresses, representing approximately 100,000 residents. At an average \$1,000 per capita in federal revenue sharing. This represents \$100,000,000.
- GIS support for Rural Legacy programs allowed the County to receive \$3,700,000, and provided the information necessary for the Department of Economic Development to apply for an additional \$2,500,000.
- GIS address-matching and geocoding allowed the County to reduce time allocated from 6 months to 3 weeks, and receive about \$20,000,000 from the state as revenue.

Return on Investment (ROI) and Cost Benefit Analyses (CBA)

ROI and CBA are economic studies that compare benefits and costs. Both can be used to consider a single option, or to find the optimal option among a range of alternatives. ROI compares net benefits to costs while CBA simply compares benefits to costs. ROI and CBA results are typically expressed in different ways (e.g. percentages or ratios). ROI is most often used to communicate the value of an investment to an organization's accounting staff and CEOs, while CBA is most often used to communicate the value of an investment to public policy makers. Therefore, ROI tends to focus on the most tangible financial gains to an organization and CBA tends to be more comprehensive. Either study type can and typically should include some assessment of intangibles. The choice of study type should primarily depend on the audience.

The ROI metric measures the rates of return on money invested by time period to decide whether or not to undertake new or further investments. Determining ROI is a useful way to set priorities within a group of viable alternatives.

ROI and related metrics provide a snapshot of financial benefits adjusted for the size and time period of the investment. In a [survey of nearly 200 senior marketing managers, 77 percent responded that they found the ROI metric very useful](#). This may be due, in part, to the focus of ROI studies on tangible financial benefits that affect the bottom line more directly than intangible benefits.

CBA is a systematic process for calculating and predicting whether the benefits of a project or policy will outweigh its costs, and how each of the alternative approaches compare to each other. CBA results are adjusted for the time-related value of money. The results are expressed on equal terms by using "net present value." CBA is generally a more comprehensive review of tangible and

intangible costs and benefits. Most CBA analyses will also factor opportunity costs into the equations.

ROI and CBA studies can serve many purposes, including:

- Determining the soundness of a decision (justification/feasibility).
- Providing a basis for comparing options – i.e., [comparing the total expected costs and benefit of each option against the other](#).
- Evaluating the desirability of a given policy.
- Putting a dollar value on intangible items and factoring opportunity costs into the equations.
- Showing the time period required for the derived benefits to repay the initial investment and the ongoing costs of operation.

Why Conduct an Economic Study for Geospatial Operations?

[Determining how to calculate and communicate the economic benefits of geospatial technologies continues to challenge public and private organizations alike.](#)

[Sustainable enterprise-wide GIS initiatives are dependent on obtaining organizational buy-in and delivering measurable results.](#) Focusing a study on the value of a particular geospatial data layer, or on how a GIS facilitates a business process within the organization, can be very useful. But it is clearly a narrow focus when compared with the more comprehensive analysis of enterprise-wide geospatial operations.

If the concern regarding GIS investments is financial, then limiting the analysis to financial costs and benefits (most often cost reductions) is one approach. If the concerns are related to whether these investments are in the best interest of the public being served, then a more comprehensive assessment of benefits is needed, even if they can't

be quantified. In either approach, one should describe all benefits and costs, quantify everything possible, and compute quantified values. In the narrative, one should supply decision-makers with enough information about intangibles to make an intelligent decision, because significant benefits are derived from many of the intangibles that GIS provides. *Sometimes choosing an option with a lower demonstrated financial return is warranted, because the intangible values will tip the balance.*

Often the term 'intangible benefits' is automatically dismissed by decision-makers who feel these benefits do not affect the total cost of operations. This is because some intangibles are very difficult to quantify (e.g. political will, statutory restriction, opposing business requirements). Other intangibles are quite easy to quantify and can add significant benefits such as: calculated efficiency increases, cost avoidance, the enhancement of analytic capabilities, and improved knowledge.

Quantitative and Qualitative Benefits

Economic studies, in the broadest sense, attempt to measure the financial security of an investment. There are different ways to make this assessment:

- Qualitative economics refers to the direction of change (+ or -) in one economic variable as it is related to change in another economic variable. Qualitative assessments recognize changes in characteristics or capabilities.
- Quantitative economics use a range of complex mathematical and statistical procedures to analyze economic phenomena. Quantitative assessments assign financial amounts to each of the costs or benefits induced by the qualitative improvements.

These techniques help economic analysts explain economic issues and understand human actions, group interactions, and community dynamics.

Questions to Consider

- Which assessment strategy is most relevant, or can both strategies be applied successfully?
- Are all of the problems and their solutions quantifiable? Should the analysis be limited to dollar values or consider a more complete array of benefits and costs?
- What is the specific target group for the study? Is it the directly affected business area, an entire organization, or the broader affected constituency including other agencies and the public?
- Will the results affect multiple levels of government in different ways with regard to costs and benefits?
- Will qualitative results be viewed as strongly? Or, is the audience only after numbers?
- Is there a way to turn qualitative analysis into quantitative results
- What about perceptions (intangibles) on any of these issues that can affect how the study results are viewed?

Risk Avoidance

- **Real Results v. Desired Results** - Perhaps the most challenging aspect of performing any economic study is the necessity to "keep it real." To avoid driving results toward predetermined conclusions, care should be taken to carry out the examinations in a scientific and objective manner. Do not simply total the highly visible costs, and then start adding up any peripheral benefit until you get the ratio you want. This technique will be quickly discovered and will negatively impact the program instead of moving it forward in a sustainable manner.

To avoid this pitfall, establish objective constraints prior to embarking on the study. While the scope of an economic study can always be modified later, having standards and firm

Studies that made a difference

#2 - [King County, Washington](#) - This was an after-the-fact ROI study documenting the cost-benefit realized over 18 years of GIS services. The results showed a conservative estimate of \$776,000,000 in total financial benefits, and from \$87,000,000 to \$180,000,000 in benefits in 2010 alone.

Dr. Richard Zerbe, an economist at the University of Washington and Director of the UW Benefit-Cost Analysis Center at the Evans School of Public Affairs, conducted the study in the following manner:

- Zerbe's team conducted face-to-face interviews with county employees to gauge the role of GIS in agencies.
- Savings in time and effort were monetized based on salary figures and full-time employee statistics to determine what it would cost agencies to replicate their pre-GIS level of output as well as the cost of replicating current production levels without GIS technology.
- Opportunity costs were calculated and had a substantial effect on the resultant ROI value.
- Benefits were measured for outputs that are quantitatively and qualitatively better with GIS, leading to

Studies that made a difference

increased demand for these outputs.

- Net benefits were expressed in three estimates, ranging from most conservative to least conservative:
 - The MOST conservative net benefits estimate was \$776 million
 - The LESS conservative net benefits benefit estimate was \$1.76 billion
 - The LEAST conservative net benefits estimate was almost \$5 billion

3 - New Zealand

This 2009 report entitled *Spatial information in the New Zealand Economy: Realising Productivity Gains*, looked retrospectively at the impact of past investments in 13 sectors, from Agriculture to Tourism and Transportation. Findings showed “[t]he use and re-use of spatial information is estimated to have added \$1.2 billion [NZ] in productivity-related benefits to the New Zealand economy. This value is the result of increasing adoption of modern spatial information technologies over the period 1995-2008, and is equivalent to slightly more than 0.6 per cent of GDP or GNP in 2008.... Had key barriers been removed it is estimated that New Zealand could have benefited

criteria will keep you in check with your initial goals.

- **Know your audience** - NSGIC represents state government geospatial operations. The audience for state GIS coordinators is comprised of decision-makers affecting state budget and program revenues. These people are primarily interested in time, money, and resource numbers. Of course, they also recognize the value achieved in citizen satisfaction, improved services rendered, and the public’s perception of those services. Your audience will be unique to your organization.
- **How good is good enough?** - How much time and money should be spent on a study to make a sound decision? The scope should be determined by what it takes to be confident that you are making a good decision. Uncertainty and imprecision are OK and almost always unavoidable. Making a bad decision is usually avoidable.

Economic studies can be effectively used to justify an investment to create or expand geospatial operations. Although it may be very interesting or impressive to determine the total value of everything, it is often more important to focus on the investment decision at hand — Is the current level of spending on GIS worthwhile, or would it be better to spend a little more or a little less on one thing or another? Subsequently, a government agency can use the assessment to justify support for the provision of services and maintenance of geospatial data.

In the studies we examined (table below), the benefits connected with geospatial data and operations were substantial. Your own study could make the case for allocating a small portion of the calculated returns toward sustaining your data production and operation.

A Sample of Reviewed Methodologies

The following table compares eight different methodologies. Opinions presented are only the general opinion of this paper’s authors and were given for comparative purposes. This is not an exhaustive listing, and evaluations were not done with a particular business objective in mind. Organizational constraints and objectives should be the determining factors in choosing a methodology. See additional documentation on methods and benefits at: http://www.nsgic.org/roi_cba_review.

Study	Overview	Strengths and Weaknesses
ESRI - The Business Benefits of GIS: An ROI Approach (2008)	A fact-based, benefits-focused methodology aimed at ensuring the sustainability of GIS initiatives by effectively demonstrating the success of the investment.	Strengths: Prepared by a GIS industry leader. Free for use. Weaknesses: Significant work is involved to implement.
Applying a benefits driven approach to GIS implementation	This is an abbreviated approach to ROI.	Strengths: Good for quick and simple analysis. Weaknesses: Nothing about initial investment or about discounting future benefits.

An Analysis of Benefits from use of Geographic Information Systems by King County, Washington	<p>Study conducted by Richard Zerbe and Associates, measuring benefits/costs accrued over 20 years of enterprise GIS use across King County government.</p>	<p>Strengths: Prepared by respected benefit/cost economist. Holistic study of measured benefits and historical costs, rather than estimates of future benefits/costs. Weaknesses: New approach, not packaged yet as repeatable methodology, and the calculated benefit is astounding.</p>
Economic Contribution of the Ordnance Survey to Great Britain	<p>The objective of this study was to provide an estimate of the then-current (1999) economic importance of the Ordnance Survey to the Gross Value Added (GVA) of the United Kingdom.</p>	<p>Strengths: The report is clear and easy to follow. It makes a convincing argument for the investments made by the Ordnance Survey. Weaknesses: It is a high level view of the issues that would be expensive to duplicate. It also requires a credentialed economist to perform the analysis and interpret and defend the results.</p>
Benefits and Costs of the Digital Coast	<p>This study reflects a full accounting of historical and expected future costs for NOAA's Digital Coast and compares them to quantifiable benefits.</p>	<p>Strengths: This is the second in a series of ROIs conducted that demonstrate that the benefits of investment outweigh the costs. It weighs the historical and projected future benefits and costs of the Digital Coast from FY2007-FY2021. It demonstrates a positive ROI without doing a costly comprehensive study. Weaknesses: To reduce the cost of the analysis, only the most easily quantifiable classes of benefits were considered. This approach requires a credentialed economist to defend these decisions.</p>
National Enhanced Elevation Assessment (NEEA aka 3DEP)	<p>The National Enhanced Elevation Assessment was conducted to (1) document national-level requirements for improved elevation data, (2) estimate the benefits and costs of meeting those requirements, and (3) evaluate multiple national-level program-scenarios.</p>	<p>Strengths: The NEEA provides a comprehensive assessment of needs and benefits across the nation. Weaknesses: High cost of the study.</p>

Studies that made a difference

from an additional \$481 million [NZ, 40%].” Those barriers fell into two major areas – lack of access to government data, and lack of skills to use that data.

The report’s conclusions resulted in the following:

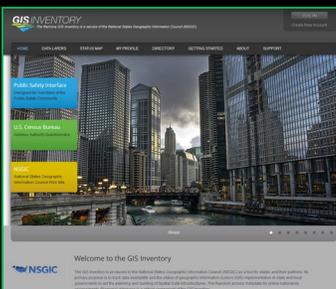
- Brought a focus to combined efforts of the government and private sector to remove those barriers.
- [Gave an underlying rationale for increasing the re-utilization of geospatial data as stated as the top priority for Land Information New Zealand’s, the national department responsible for land titles, cadastral mapping, etc.](#)
- Supported Cabinet approval of NZ\$5 million for a series of GIS projects related to the development of a Canterbury region spatial data infrastructure as part of the 2011 earthquake rebuilding effort.



NSGIC is a 501 (c) (6) organization committed to efficient and effective government through the prudent adoption of geospatial information technologies. Voting members include the senior state geographic information system managers and coordinators. Other members come from federal agencies, local government, the private sector, academia and other professional organizations. NSGIC members include nationally and internationally recognized experts in geospatial information technologies and policy.

NSGIC provides a unified voice on geographic information and technology issues, advocates State interests and supports its membership in their statewide initiatives.

NSGIC reviews legislative and agency actions, promotes positive legislative actions and provides factual information to public and private decision-makers. It also provides services such as the GIS Inventory.



<http://gisinventory.net>

<p>Estimating GIS Return on Investment the Empirical Way</p>	<p>A detailed methodology that breaks down costs and benefits into small, quantifiable elements. Both costs and benefits are based on actual experience from several similar agencies, plus the empirical experience of the subject agency's managers.</p>	<p>Strengths: Indicates how "qualitative benefits" which were previously discounted can be quantified through a consensus-building process. Weaknesses: Does not analyze all the costs and benefits of online and cloud-based operations.</p>
<p>Spatial information in the New Zealand economy</p>	<p>Looks at entire New Zealand economy, sector by sector. Determines the total benefits to the national economy realized from adopting geospatial operations. Asked sector representatives about how work was done with and without spatial information. Savings are incorporated into a general equilibrium model to see impacts on the national economy.</p>	<p>Strengths: Nice overview of benefits of GIS to various sectors: 75 pages of examples in 13 sectors. Especially valuable look at impact barriers to data and technology availability. Contains good background material on economics. Weaknesses: Very intensive work. People might not understand or appreciate the final economic model.</p>

IN CLOSING, we encourage the use of systematic and well-accepted economic studies that provide a clear rationale for ongoing budgetary support of geospatial operations WITHOUT charging for public geospatial data above the direct cost of duplication. Open access to information is one of the fundamental principles that our nation was built upon. It fuels commerce and the development of innovative technologies which have a measurable positive impact on the economy.



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