

Socio-Economic Benefits Study:

Scoping the Value of CORS and GRAV-D

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Summary

Objectives

This is a scoping study to provide the basis for a full analysis of the socio-economic benefits of CORS and GRAV-D to the United States. The objective is to address the questions:

1. Who benefits from CORS, GRAV-D or both?
2. What is the nature and basis of these benefits?
3. What methodology is appropriate for estimating the value of CORS and GRAV-D to society?
4. What information is needed to estimate the values and how can it be obtained?
5. What are the estimated order of magnitude values of socio-economic benefits for CORS and GRAV-D?

The NGS Continuously Operating Reference Station (CORS) system is the cornerstone of the geometric component of the National Spatial Reference System (NSRS). It provides observations from over 1,320 stations in the United States, its territories and a few foreign countries to enable precise positioning. GRAV-D — Gravity for the Re-definition of the American Vertical Datum is a project whose goal is to redefine the vertical datum of the United States and replace geodetic leveling in large areas with GPS measurements and a gravimetric geoid model to determine orthometric heights more efficiently and accurately than with the current datum.

CORS and GRAV-D Trade Space (footprint) Measures

Surveying and mapping services amounted to \$4.9 billion of direct economic activity in 2002, according to the Economic Census. In addition there were \$1 billion in sales of maps and atlases in print and electronic form. Business revenue from surveying and mapping is estimated at \$8.0 billion in 2008.

The U.S. Bureau of Labor Statistics (BLS) estimates survey-related employment in 2006 as:

Surveyors	60,000
Cartographers and photogrammetrists	12,000
Surveying and mapping technicians	<u>76,000</u>
Total	148,000

The overall number of persons employed in surveying and mapping is estimated here as 170,000-200,000.

Potential users of spatial information include employees in a wide range of occupations. The

thousands of civilian federal employees are in functions that are major users of spatial information. In 2007 there were 76,000 non-school state and local governments and special districts, many of which rely on the information as well.

Gakstatter and Lorimer have estimated the number of precision GPS users worldwide at 300,000 in 2008. This is consistent with Leveson's projection of 75,000 in the U.S. in 2008 that was made in the 2006 L2C study.¹ Leveson projected the number of precision users in the U.S. at 146,000 in 2012 and 333,000 in 2017. Gakstatter and Lorimer estimate purchases of GNSS equipment, software and services that can provide horizontal positioning of 10 cm or less using GNSS technology as \$3 billion in 2008 under their "realistic" scenario and project \$6-\$8 billion globally by 2012.

There were 10.6 million CORS downloads in Fiscal Year 2008, with the vast majority using the Internet's anonymous file transfer protocol (FTP). The number of CORS data downloads, weighted by the estimated values per download of each type, has been growing by 22% per year since 2003. OPUS will continue to grow over the next several years because of the cost savings and convenience it offers. New services: OPUS-DB, OPUS-Projects, OPUS-Mapper, and CORS offerings of real time information without corrections will increase use and value. Usage could be stimulated by initiatives of large vendors. Demand for real time information will increase as surveyors, engineers and environmental and resource scientists shift from post-processing to be able to verify observations on site and avoid rework.

GRAV-D will largely reduce the need for long line leveling. The amount of long line leveling per year by all organizations is estimated very preliminarily as 65,000 km, of which 26,000 km is performed by private survey firms, including work for governments.

GRAV-D will provide height information for floodplain management. Approximately 100,000 buildings per year are built in special flood hazard areas of communities that participate in the National Flood Insurance Program.

Benefit Measurement Approach

A preferred approach to benefit measurement is the economic productivity approach which emphasizes incremental cost savings and productivity gains to users. The use of avoided costs is a valid conceptual way of determining the efficiency gains that are at the heart of the economic productivity approach. Incremental value estimation considers the benefits above those that would have existed in the absence of a program. The approach takes into account the technological alternatives that would be manifest if CORS and GRAV-D were not available and their relative use and cost. Estimation for GRAV-D focuses on the costs avoided by not having to do long line leveling and the benefits to floodplain management.

Since GRAV-D will become available in later years it is necessary to analyze its evolution and prospects under scenarios for possible future environments. Scenarios can increase understanding by organizing a collection of prospects into an overall theme. Three scenarios are presented, the

¹ Eric Gakstatter, "Precision Market to Reach \$8B by 2012," *GPS World* (November 2998), pp.27-30 and Irving Leveson, "Benefits of the New GPS Civil Signal: The L2C Study," *Inside GNSS* (July/August 2006), pp.42-56.

“standard” scenario in which GRAV-D is completed by 2019, a “stretched” scenario with GRAV-D beginning two years later and taking a year longer to complete, and a “climate change driven” scenario which has profound effects on the demand for GRAV-D. These are to be compared with a baseline scenario in which there is no GRAV-D.

Information Needed and Approach for Obtaining It

Information Needed

The information needed for a full analysis includes:

- Technological alternatives for each user group if CORS and GRAV-D were not available.
 - Including for CORS, the availability of public and private RTN’s.
- Costs of each technological alternative.
 - Cost of traditional positioning.
 - For CORS, the cost of public and private RTNs and other alternatives.
 - Costs of added monumentation for state government users.
- The magnitude of the trade space (footprint) that directly benefits from the cost savings.
 - For CORS, the amount of use of different technologies.
 - For GRAV-D, the amount of geodetic leveling longer than 2 km and the numbers of buildings affected by improved floodplain management.
- The benefit to those that would not use traditional positioning because the value to them is less than its cost.
- The reduction in damages to buildings from improved floodplain management.
- Consumer surplus estimates.
- Estimates of broader societal benefits.

A study is envisioned in which quantitative and qualitative information will be obtained from public and private providers and users. User Forum discussions, surveys and interviews will be employed to provide contexts and building blocks for benefit estimates. The information will be used along with databases and information reported in the literature to further understand customers and how NGS programs are used, identify opportunities for case studies and provide a foundation for estimates. The product of the full study will be estimates of the value of CORS and GRAV-D and supporting information.

Study Components

User Forums will provide opportunities for group and individual discussion and for some surveys and interviews.

Several surveys and extensive interviews will be required. Interviews may be preferred over surveys where greater depth is required than is possible with the amount of time numerous participants are willing to devote to a survey. It may be possible to obtain some information on usage, costs and future plans from interviews with a few large vendors with current or potential prospects for large usage such as Trimble Navigation and TOPCON. Such cases will be explored early on to ascertain whether such interviews can provide information more economically than surveys of customers. The help of professional associations and trade publishers will be elicited in reaching their members or subscribers.

NOAA has experience with a number of firms that provide contact lists and firms that conduct on-line and telephone surveys. Some have questions that have been pre-approved by OMB. There may be opportunities to build on the NGS GPRA County Scorecard Survey to obtain information from groups such as county engineers and surveyors. This survey has received fast track approval from OMB in meeting the Paperwork Reduction Act (PWA) requirements. Some surveys and interviews can be designed as components of the Performance Assessment Rating Tool (PART) required by OMB to contribute to meeting assessment requirements and facilitate PWA approval.

Two types of case studies will be developed:

- Those that rely largely on information where important changes in measurement have occurred. Where possible, the case studies will compare areas with different geodetic capabilities and make before and after comparisons where CORS stations or monuments have been added and/or other improvements in measurement have been made.
- Those that obtain information from survey firms on the impacts of their efforts and information on cost savings and productivity improvements.

Several approaches to obtaining data will be selected from the following:

- Conduct CORS and Height Measurement User Forums.
- Interview large vendors of services that rely on the NSRS.
- Interview and/or survey state geodetic advisors.
- Interview and/or survey state Height Modernization Program Managers.
- Interview and/or survey private surveying firms.
- Interview and/or survey federal agencies regarding their use of CORS and elevation information and their alternatives.
- Interview and/or survey state and private RTNs.
- Interview and/or survey customers of selected state RTNs.
- Survey members of the Association of State Floodplain Managers or state floodplain management associations.
- Survey members of the National Emergency Managers Association.
- Survey members of other professional associations.
- Survey subscribers to trade publications.
- Collect information on the extent of long line leveling, damages in floodplain areas and

other components for estimation of benefits of GRAV-D through contacts with public officials, interviews and searches of data and reports.

- Conduct case studies of areas where improved measurement has occurred and information can be obtained for analysis of the improvements.
- Contract with survey firms to write up their information on costs of alternatives and savings from technological improvements or increased coverage.
- Conduct a separate analysis of the value of the CORS program to NOAA's Space Weather Program.

The body of the report provides lists of possible questions to be addressed to public and private organizations and professionals.

A Strategy for Getting Started

The study can begin with a first stage that moves forward with as much as can be done immediately, while setting in motion the processes that set up and enable activities that require substantial preparation and lead time. The first stage can include the following:

- Determine specific meetings, surveys and cases for analysis.
- Develop email and contact lists for surveys, interviews and forums.
- Finalize questionnaires, interview protocols, and survey methods and explore arrangements with other organizations and potential contractors.
- Submit questionnaires and interview protocols to OMB and respond to their questions.
- Estimate costs of subsequent portions of the full study, develop contract requirements and evaluate potential contractors.
- Collect data and conduct analyses that do not require OMB approval.
 - e.g. User Forums, interviewing and/or surveying NGS state geodetic advisors, estimates of components of benefit analysis that are possible initially such as several components of GRAV-D benefits for floodplain management.

Some Order of Magnitude Benefit Estimates

An illustrative order of magnitude of benefits of NSRS is \$2.4 billion per year. This is derived by building on revenue from private surveying and mapping, adding assumptions for the government and not-for-profit sectors and adding a factor for societal benefits. The \$2.4 billion per year, extended over 15 years and discounted at 7%, leads to a present value for the NSRS of \$22 billion. If benefits grew at 7% per year, the discounted value would be \$36 billion.

An estimate of CORS benefits is made by adjusting the NGS estimates to account for the fact that not all users would be willing to pay the full cost of obtaining data from a station and adding a factor for societal benefits. The order of magnitude of CORS benefits is estimated as \$758 million per year. The present value of these benefits, discounted at 7% over 15 years, is \$6.9 billion even without future growth. If benefits grew at a 15% annual rate, less than the recent growth rate of 22%, the order of magnitude of the present value of CORS benefits over the next 15 years would

be \$18.5 billion. These figures do not include deductions for government and private costs of providing CORS data.

The value of benefits that GRAV-D might have under current conditions is estimated based on avoided costs of long line leveling and benefits of improved floodplain mapping through building standards in vulnerable areas and avoidance of vulnerable areas. Business receipts of firms marketing the product lines “geophysical data acquisition, processing and interpretation” are used in estimating avoided costs of long line leveling. Assumptions are made for the size of revenues of governments and not-for-profit organizations relative to those of private firms, proportions of the activities of each sector that consist of long line leveling and of benefits above user costs (consumer surplus) and societal benefits. The order of magnitude of these benefits of GRAV-D is estimated as \$282 million per year. Discounting annual benefits of \$282 million over 15 years at a rate of 7% yields a present value of benefits of GRAV-D from avoiding costs of long line leveling of \$2.6 billion.

A conjectural estimate of the benefit of GRAV-D for floodplain management under current conditions is \$240 million per year. This is based primarily on the avoided cost of flood damage to buildings. The present discounted value of benefits of \$240 million per year over 15 years is \$2.2 billion. Combining the \$2.6 billion estimate of the benefits of GRAV-D in avoided costs of long line leveling with the \$2.2 billion from improved floodplain management yields a combined conjectural estimate of the present value of benefits of GRAV-D over 15 years of \$4.8 billion. Properly valuing GRAV-D requires quantifying its benefits under scenarios for its evolution under future conditions.