

Space Economic Data

December 2002



Prepared by
Henry R. Hertzfeld
THE GEORGE WASHINGTON UNIVERSITY
Elliott School of International Affairs
Space Policy Institute

Prepared for
THE U.S. DEPARTMENT OF COMMERCE
Office of Space Commercialization

Space Economic Data

Prepared by

Henry R. Hertzfeld

**The George Washington University
Elliott School of International Affairs
Space Policy Institute**

2013 G Street, NW
Suite 201
Washington, DC 20052

Prepared for

**The U.S. Department of Commerce
Office of Space Commercialization**

Herbert C. Hoover Building
14th and Constitution Ave., NW
Washington, DC 20230
(202) 482-6125, 482-5913

December 2002

This report was prepared under U.S. Department of Commerce Contract #SB135901W1394 with the Space Policy Institute, The George Washington University, Washington, D.C. The opinions and conclusions are those of the author and do not necessarily reflect either those of the U.S. Department of Commerce or of the individual participants in the Workshop on Space Economic Data held in October 2001.

Table of Contents

I.	Executive Summary	1
II.	Introduction	5
III.	Background	9
IV.	Key Issues	19
V.	Recommendations	25
VI.	Additional Options	33
VII.	Appendix: Space Economic Data Workshop	37

I

Executive Summary

Space research, development, and commercial activity are among the important leading-edge technological sectors in the nation and in the world. Yet, we know less about the space industry than we do about other sectors of the United States economy. One area of confusion is that there are different definitions of the space sector in use by different statistical agencies. Both domestic and worldwide estimates of the size and growth of the industry vary greatly. Economic data on many components of the space sector are combined with unrelated industries. Dual-use products and services (defense and commercial) are characteristic of the industry. Basic questions remain unanswered. How important is the space sector to the overall economy? What economic factors have driven the growth and change in space activities and how fast have they occurred? Both government and private sector space officials and analysts have called for better planning and policy tools that require better, more comprehensive, more consistent, and more uniform data.

This report addresses the current state of knowledge of space as it is reflected in published data reports. Options available to improve the collection and distribution of space economic data are reviewed. The report offers specific recommendations for making space economic data more accurate, reliable, and available. Much of the information contributing to this report is derived from an October 2001 workshop involving experts in the field, sponsored by the Office of Space Commercialization, within the U.S. Department of Commerce (DOC), and the Space Policy Institute at George Washington University.¹

This report suggests that the dialogue initiated at the October 2001 workshop, involving both government and private sector experts, be continued and expanded. The report recognizes

¹The recommendations in this report are the responsibility of the author and should not be attributed to any specific individual attending the workshop or to the DOC.

the challenges inherent in working to significantly improve space economic data and therefore recognizes that the U.S. Government, facilitated by the DOC, could work toward this objective through an incremental process. An option for limited initial action involves compilation of current information available from the DOC data collection efforts and databases. A more ambitious initiative would also include space data from other government agencies. In the context of either DOC-only or government-wide compilation of data, the DOC could encourage agreement on defining the space sector more clearly and setting standards for data quality. In addition, the DOC could coordinate efforts to create a user-friendly clearinghouse that would facilitate public access to data held by voluntarily participating government agencies and private sector organizations.

In summary, the report's four major recommendations are:

- 1) establish an on-going dialogue involving government, industry, academia, not-for-profit, and foreign space economic data producers and users,
- 2) develop an inventory of existing government data on space economic and business activities.
- 3) encourage development of clear definitions of space activities and standards for space economic data quality, and
- 4) develop effective methods for improving access to space economic data, and explore the feasibility of a central, publicly accessible electronic warehouse.

Beyond these initial limited steps, a number of larger-scale options are also considered, including more active data collection on space activities by the government. Special surveys could be developed to view space not only as an economic activity similar to other industries, but also as a unique sector that is organized in three major modes: terrestrial activities, access to space, and activities in the microgravity environment of space (including suborbital activities and orbital satellites, as well as in-space projects on the Shuttle, the International Space Station, and future space vehicles and platforms). State and local officials interested in developing regional models might also help design instruments to provide policy and planning information on local impacts of new space business. In addition, because government space programs are becoming partnerships with private and international entities, better commercial space data would be helpful in evaluating and planning for equitable financial arrangements in these cooperative programs. The specifics of how to develop new data series are beyond the scope of this report, but additional future studies could explore technical issues not addressed here.

DOC personnel directly involved with space issues could also work more closely with the Bureau of the Census in advocating the separate delineation of major sectors of space economic activity as part of the ongoing process of defining the North American Industrial Classification System (NAICS) codes for industry. In addition, since foreign nations also lack reliable and accurate information on their space economic sectors, the DOC could work, in cooperation with other U.S. agencies, with foreign entities to reach agreement on defining the space sector in all nations and on creating data so as to make meaningful international comparisons possible.

Taken together, the foregoing considerations strongly suggest that it is time to devote serious effort to improving space economic data. But progress in understanding the space sector through better data methods will be slow, given that economic data normally have a time lag between collection and publication of a year or more. Further, because some of the most important uses of economic data involve time-series analyses, even major improvements today will not yield optimally useful information until many years of data have accumulated. Further delay in addressing space data challenges will only render future analytical efforts even more difficult.

II

Introduction

The Commission on the Future of the U.S. Aerospace Industry has clearly recognized the lack of current and adequate aerospace data:

“The current federal budget process does not include a comprehensive aerospace budget breakdown, leading to an unfocused and uncoordinated allocation of government resources,” stated Commission Chairman Robert S. Walker. “Such a disjointed process lacks the necessary focused accountability for the development and leadership of a coherent national aerospace program.” Commissioner John Douglass noted that past sectoral industry spending figures are known with a two-year time lag, and there is currently no capability to assess future investments by sector.

Commission statements further observe that currently, federal government aerospace spending is spread across multiple departments and agencies, with oversight by numerous and different Congressional committees. As a result, none of these groups has an integrated view of our national aerospace efforts.”²

The Commission’s comments underscore only one part of a much more complex set of issues dealing with measuring the U.S. aerospace sector, and in particular, the components of this sector including space. As noted above, the sectoral analysis is highlighted as a problem of data inadequacy. Not only could federal budget figures be broken down in more readily usable ways, but data on commercial research and development (“R&D”) and expenditures in space could also be greatly improved with regard to consistency, detail, and timeliness for use in any number of important areas,

² <http://www.aerospacecommission.gov/122001release.html>

including government policy making, corporate strategic planning, marketing, and financial investment analysis.

The space industry is now global, sharing statistical and data problems with many other industries. Foreign and international statistics may not be comparable in terms of completeness and have additional problems with cross-national comparisons. There is no coordination among industry definitions internationally. And, there is little comparability across nations in government budgets. Finally, foreign data are sometimes difficult to locate and translations as well as social and cultural differences complicate the understanding and analysis of the data.

There is also a definitional problem in measurement that sometimes results in “double counting” of the same expenditures (i.e., government expenditures also appear in industry sales figures) because private firms build and launch government space equipment and services under contract. And, even if the data are not double counted, the definition of what is a “commercial” launch vs. a government launch is not clear and has been treated differently in different statistical reports. Time is an additional problem because most government budget figures are on either an “authorization” or “appropriation” basis, not actual outlays in a given year. Corporate data are often provided by calendar year rather than the U.S. Government’s October through September fiscal year. Finally, separating civilian space activity from defense and security related space programs is often not possible, either in the United States or abroad.³

The sense that a new review of space economic data issues might result in suggestions for improvement prompted the Office of Space Commercialization, within the U.S. Department of Commerce, and the Space Policy Institute at George Washington University to undertake a joint space economic data project. A workshop was held on October 16, 2001, to discuss the subject.⁴

³The annual U.S. budget is publicly available and contains information about both civilian and defense space programs. However, many functions overlap, and many expenditures are assigned or attributed to non-space categories. For example, the salaries of personnel who oversee a variety of space and non-space programs often are not separable into distinct categories. And, of course, classified programs are not clearly categorized in the public budget. Foreign space programs are even more difficult to separate into civilian and military components (as well as into other functional categories). Some nations deny the existence of internal military space activities when they actually exist; some are users of space information (e.g. remote sensing imagery) but have no active space R&D or production facilities; and some have budget and economic data reports that use definitions and categories that are incompatible with comparisons across nations.

⁴This report, it should be emphasized, is not a summary of the workshop. It is based on the information collected in preparation for the workshop as well as on the expert opinions presented at the workshop. The analysis, conclusions, and recommendations of this report are the responsibility of the author and do not necessarily represent the specific views of any particular persons or groups, including the U.S. Department of Commerce, who have provided inputs or information either to the workshop or to this study.

Drawing upon both the workshop and other available sources, this report has the following objectives:

- to assess the history and current state of space economic data,
- to review options for improving space economic data, involving standards of data quality, space sector definitions, data collection, and data dissemination, and
- to discuss possible government roles in future space economic data activities.

III

Background

History

A civilian space industry that included commercial space activity did not exist prior to 1958 and the formation of the National Aeronautics and Space Administration (NASA). The U.S. Department of Defense (DOD) was responsible for space research. The creation of NASA and the rapid escalation of expenditures on civilian space activities during the Apollo program of the 1960s marked the beginning of a large commitment in the United States to the design, development, and manufacture of space hardware and services for non-military purposes. Outside of a relatively small number of communications satellites, the major purchaser of these goods and services was the U.S. Government. From the beginning of the space effort, the U.S. Government made the decision to contract with U.S. industry to produce most space equipment rather than manufacture it within government facilities. R&D efforts were shared between government laboratories and private companies.

Commercial space efforts with the government as the major purchaser could be measured and tracked relatively accurately through government procurement records.⁵ The need to integrate these expenditures into separate industrial sectors for policy purposes was minimal in the early stages of the development of space activities. And, since the products were often produced in parallel with somewhat similar military equipment, the separation of civilian from military functions was difficult.

During the early years of space (approximately 1960 to 1980), the commercial communications satellite industry was not a large enough production item in the national income accounts to be

⁵ Since 1958 NASA has published annual procurement reports that document the awarded contracts and grants to industry, universities, and non-profit organizations. (These data are for the total amount of the contract awarded, not the amount expended or allocated in a given year, and that makes it difficult to use the data for economic impact analysis. The information, nonetheless, provides a starting point for some types of policy and strategic planning.) The companies, geographic distribution, and nature of the award are available. The DOD also has similar annual reports, but separating space activities from other activities is more challenging in this context.

considered a separate industry and was considered as part of the very large radio and television equipment sector.⁶ Spin-off consumer and industrial space products were (and still are) correctly considered part of the industries producing the products and were essentially untraceable in economic databases back to the original space funding or research effort.

The space industry has matured since the 1960s. Several important trends have emerged that now make it more challenging to use existing statistics to track and evaluate the changes in the space sector of the economy. First, the total expenditures on space have grown. Government civilian space is approximately \$14 billion in the United States; defense space expenditures are on a similar scale.⁷ Some estimate private sector commercial space activity to be more than the combination of U.S. Government civilian and defense expenditures.

Second, space is now a global industry. Although the U.S. is the leading nation in space, Europe, Japan, Russia, and many others have very capable government space programs as well as fast-growing private companies in the space business. This is also evidenced by the rising trend of U.S. imports of space goods and services.

Third, although telecommunications satellite business remains the major commercial space activity, rapid growth of the use of the global positioning satellite system, remote sensing, and commercial launch activity have stimulated a number of new private sector space companies and initiatives.

Our understanding of the space industry is clearly less than comprehensive. The statistics developed in the past for space activity no longer suffice to provide even a relatively complete picture of ongoing initiatives. Existing definitions are similarly limited, in that they present components of space-related economic activity but do not present space as a separately defined industry.

⁶ Today the space component of the communications business is a multi-billion dollar industry, although it is only a small percentage of the total communications sector. However, there is still no separate category in the U.S. national income accounts for the manufacture of satellites. Until the late 1980s all launch vehicles in the U.S. were under the control of NASA or the DOD. (Some upper stages for commercial communications satellites were built directly for commercial customers.) The commercial expendable launch vehicle industry in the U.S. has grown to be a \$4 billion industry, but still is not separated from the more generic “guided missiles and space equipment” (SIC 3761, NAICS 336414) in the U.S. national income accounts.

⁷ NASA, Aeronautics and Space Report of the President, FY 2000, Page 126. It is important to note that the most recent volume is now two years old.

Existing Data Sources

To gain a better understanding of the kinds of issues noted above, it is useful to consider specific data sources that currently exist. There have been many studies of space activities that include industry and economic statistics. Most of these analyses were conducted to support a specific program (e.g. Space Shuttle), a specific space activity (e.g. remote sensing), or a special commission or need. The statistics in these one-time studies are often taken from readily available sources and presented in tables and diagrams aimed at either telling a particular story or advocating a specific activity. In the relatively rare case where an original study or survey has been conducted, the methodology of data collection and analysis is frequently not well documented.⁸ In short, these studies provide informative and useful “snapshots” of space activity but cannot be relied upon for developing uniform, reliable, verifiable, and accurate space industry data. Annual reports and annual sets of statistics on space activities have also been published. However, many of these statistical series contain only top-level summary data and cover a fairly limited time frame. There is clearly little coordination among the data sets just described.

The general comments offered above can be rendered somewhat more concrete through a brief review of some of the more important space economic data documents that currently exist.

- **The U.S. Dept. of Commerce *Space Business Indicators*, published only in 1990 and 1992**

These two documents were the first attempt by the Federal Government to compile a comprehensive summary of private space investments by category (i.e. launch, remote sensing, telecommunications, etc.). However, the data were taken from many different sources and lacked consistency across fields. The emphasis was on space business investments and revenues and did not attempt to document government programs. This effort was not repeated after the 1992 edition.

⁸ This report is not suggesting that firms release proprietary data. However, it would be helpful to the users of the data if information concerning the size of the sample used, the types of firms surveyed, the rates of response, and other pertinent summary information were routinely included with reported data.

- **The U.S. Dept. of Commerce section on space in *Industrial Outlook* (annually prior to 1995) and *The U.S. Industry and Trade Outlook* (published between 1995 and 2000—not issued annually)**

The Department of Commerce, International Trade Administration (ITA), has authored this publication, drawing on both public data sources and additional analyses specially prepared by ITA economists. All projections have been formulated by ITA staff. A chapter on space commerce is part of the report, compiling space-related information from other sections of the document, as well as additional public source data and associated analyses. For example, global positioning equipment appears in the navigation equipment section of the report, launches in the space transportation section, communications satellites in the radio and TV equipment section, etc. The organization follows the Standard Industrial Classification (SIC) categorizations, which, as described elsewhere in this report, do not classify space as a separate “industry” or economic activity. Prior to 1995, the Department of Commerce published the report through the Government Printing Office. For the years from 1995 onward, the Department has selected McGraw Hill as the publisher.

- **Aeronautics and Space Report of the President (NASA)**

“The National Aeronautics and Space Act of 1958 directed the annual Aeronautics and Space Report to include a ‘comprehensive description of the programmed activities and the accomplishments of all agencies of the United States in the field of aeronautics and space activities during the preceding calendar year.’ In recent years, the reports have been prepared on a fiscal year (FY) basis, consistent with the budgetary period now used in programs of the Federal Government.”⁹

Although it presents a comprehensive description of space activities across U.S. Government agencies, this document has few economic statistics. The appendix

⁹As described in the NASA History Office web citation (<http://history.nasa.gov/presrep00/home.html>)

includes a useful agency-by-agency annual total of U.S. budget authority for space expenditures on a current and constant dollar basis. However, no detail below agency totals is presented.

■ **Other NASA Publications**

Annual Procurement Reports (1958 to present)

■ **National Science Foundation**

Science Indicators is a biannual comprehensive review of the research and development activities in the U.S. and abroad. It includes statistics and data from U.S. Government R&D activities as well as industrial activity. Data are presented on employment, sales, foreign nations, and academic discipline research. Space activities are not easily separated from broader categories or agency activities in the data.

■ **U.S. Department of Transportation (DOT) / Federal Aviation Administration (FAA) Aerospace Forecasts**

The FAA publishes a combination of historical analysis and prediction for the categories of activities falling under its jurisdiction. Space was added to these forecasts in the 1999 edition. But, the emphasis is on commercial launch activity, which is the part of the space sector the FAA is given responsibility for licensing and promoting. The data reflect the compilations the FAA makes and publishes in other reports (see below).

Since 1997, The Commercial Space Transportation Advisory Committee (COMSTAC) of the FAA has issued an annual forecast of commercial space transportation.

- **DOT/FAA Office of Commercial Space Transportation Quarterly Launch Reports (and other launch-related reports)**

The FAA has published quarterly and annual reports documenting commercial launch activities. Included with these data is information about payloads launched and some economic information about prices. The database does not include information about revenues derived from activity in space.

- **Aerospace Industries Association - AIA (chapter in *Aerospace Facts and Figures*, annually)**

The AIA has for many years developed and published a time series of useful aeronautics and space information. The data for space are not as comprehensive as that for aeronautics, but the database is of great interest and importance because it uses consistent methodologies over time. The data are derived from government documents and other available information. In addition, the AIA commissions the Bureau of the Census to do a survey of corporate inventories of aerospace products. The data sponsored by AIA are now embedded in a report called *Civil Aircraft and Aircraft Engines*. The AIA also includes data on imports and exports of aerospace products. However, due to the structure of U.S. SIC and NAICS categories, the data series for space are not clearly separated from the total figures given for aerospace. The data are also highly aggregated and are consequently not available for detailed space program or product-level analysis.

- **American Institute for Aeronautics and Astronautics (AIAA), *Aerospace America* survey and article on international civilian government space activities by H. Hertzfeld & G. Ojajeleto (annually since 1992)**

Each year since 1992, foreign governments with space programs have been sent a questionnaire on their civilian government space expenditures. The results have been published in an article in *Aerospace America*, usually in the July or August issue with results from the prior year. The data include total expenditures as well

as detail by major program category. A time-series of trends in foreign expenditures has been analyzed, and the overall statistics appear to be generally consistent with other independently made surveys.

- **SpaceVest (with others; 1997, 1998), International Space Business Council (2000, 2002)**

Independent financial/consulting firms have published *State of the Space Industry*. This document contains a financial and economic review of the space sector. The information is derived from a variety of existing government, foreign, and industry/trade association sources.

- **Teal Group**

The Teal Group publishes a continuously updated set of data on launch vehicle activity.

- **Futron Corporation**

Futron has developed an independent capability to survey the space sector and has created an annual database since 1997 on space investments by private companies worldwide. The database is kept current, and is published annually. Some of the funding for this effort is from contracts with the DOT/FAA, the DOC, and NASA. Futron has also carried out an extensive annual survey on behalf of the Satellite Industries Association. As with Euroconsult data (see below), the emphasis tends to be on the satellite communications industry, which is the largest commercial space activity.

■ Euroconsult

Euroconsult is a French consulting firm that publishes a database of space investments on a subscription basis. The emphasis is on satellite communications, but the database includes all aspects of space expenditures.

■ Eurospace

Eurospace is a trade association of European industrial space companies. In 1985 Eurospace first published a directory of European space firms as well as summary expenditures by governments. This publication was updated annually. Each year since 1997, Eurospace has published *Eurospace Facts and Figures*, which presents industry revenue data from a survey of European space firms.

■ ANSER: *Decision Maker's Guide to International Space*

Anser, a U.S. defense contractor, developed a database of space information during the 1990s and published some of the data in several annual volumes. The emphasis was on launch vehicle information, but the database did include selected economic statistics. It has not been published in recent years.

In addition to the above reports, there are also statistics on the stock market and financial performance of firms in the space industry published by Space News, Aviation Week, Business Week, and other financial magazines and newsletters. These are useful, but since most companies in the space business area also have sales in many other industries, it is not possible to develop a "space index" very accurately. The data sources for this information are from publicly reported securities, stock market, and other sources. Securities and accounting data use definitions of R&D, sales, profits, and other financial parameters that originate from the Internal Revenue Code, the Securities and Exchange Commission, and the Financial Accounting Standards Board. These definitions have been made for tax and regulatory purposes and differ in detail and purpose from those used by the Department of Commerce for census and national income accounting.

In summary, review of the above space economic data examples suggests that some major sources of *original* data on the space sector are:

- U.S. and foreign government publicly available budget documents that primarily categorize planned expenditures for a period of years.
- Government procurement reports that document total financial commitments in a given year. (Note that both these reports and the budget documents do not report actual outlays in a given year and that categories of expenditures—by industry, firm, program, project, etc.—are not consistent across all government documents.)
- Other government publications (Bureau of the Census, Bureau of Economic Analysis, FAA, NASA, etc.) with statistics that are part of routine industry reporting (where space components are difficult to separate from higher-level industry totals) or special surveys done on a regular basis for selected components of the space sector.
- Firm-level financial reports. (Only a very few firms exclusively produce space goods or services. Therefore most reported data represent combined space and non-space statistics.)
- Privately funded surveys, such as the Satellite Industries Association survey performed by Futron.
- Foreign industry and trade association sponsored surveys such as: the European space industry survey performed by Eurospace, the Society of Japanese Aerospace Companies survey of Japanese space industry, and the British National Space Center survey of space activities in the UK.
- Privately funded market analyses performed by financial and consultant groups. (The source of the published information is often confidential and unavailable for public review.)

The foregoing review of existing space economic data issues and sources has left some important questions unanswered. These include:

- What additional original sources of data exist (i.e., not included in the above review)?
- What are the statistical reliability and validity of existing data?
- To what extent are the various data sets using the same sources, and what accounts for the variability in reporting?
- Can the space sector (and its various components) be separated from the broader classification levels commonly used in government and industry data?
- Are the data flexible enough to produce a variety of data sets useful to analysts and planners for different purposes (e.g. by types of products/services, by types of space activities, by geographic boundaries, etc.)?
- What data are missing from existing databases that may be required for particular studies, reports, projects, analysis, etc.?
- Is it possible or feasible to collect all of the data into a single source? If so, what resources would be required to create and maintain the database?
- Is there an analogy to other industries that have faced similar data problems? If so, how has that industry approached a solution?

IV

Key Issues

Sector Definition and Data Classification

Given the great importance of the data definition and classification issues considered earlier, closer examination of the subject is clearly justified. Most industries are represented in U.S. Government statistics by a unique classification in either the former Standard Industrial Classification (SIC) system or the replacement North American Industrial Classification System (NAICS). Space economic activities, however, do not have a unique industrial category in this classification system. Space activities straddle broader classification codes such as: transportation equipment (guided missiles and space equipment are lumped together), radio and TV equipment (communications satellites are included here), optical instruments (remote sensing cameras), and navigation equipment (GPS receivers). Consequently, official government data publications do not allow for space to be precisely identified as a distinct economic activity. When relying on government databases, current measures of space within the overall economy must simply be approximated. Furthermore, since there is no official “space sector” in government data publications, there is also no standard for defining what should be included and what allocated to other sectors. The following box illustrates some of the industry combinations that place space activities within broader categories involving other industries.

NAICS CODES AND SELECTED SPACE PRODUCTS

Manufacturing

Computer and electronics equipment	334
Computer equipment	3342
Radio & TV equipment	334220
Search, Navigation, etc. equipment	334511
Transportation Equipment	336
Aerospace Products and Parts	3364
Guided Missile & Space Vehicles	336414
Note: <u>Space satellite manufacturing:</u>	<u>in 334220</u>
<u>Global Positioning systems</u>	<u>in 334220</u>

Non Manufacturing

Information	51
Broadcasting & telecommunications	513
Radiobroadcasting	51311
Radio networks	513111
Cable networks & program distrib.	5132
Cable networks	513210
Telecom	5133
Satellite Communications	513340
Other telecom (satellite tracking)	513390
Note: <u>Satellite radio</u>	<u>in 51311</u>
<u>Satellite TV (with cable networks)</u>	<u>in 51311</u>

Source: Jack Triplett, Brookings Institution

Given current difficulties involving classification and definition, one response might be to refine the NAICS system in order to separately identify various sectors of space activity. Some industry representatives, particularly those involved in marketing and strategic planning, are keenly aware of the shortcomings of the classifications and the data. However, others in industry that are required to compile the data for the government questionnaires and surveys may only regard this government exercise as a nuisance requirement and never be in a situation to actively use the results of the surveys. These industry officials may be from different parts of the very same companies where some are calling for better data. Clearly, it depends on where one sits in industry and who happen

to be official representatives to the DOC and other agency committees. It is important to note that the AIA, a U.S. space industry trade association, clearly supports data improvements in the space sector, as does Eurospace, the European counterpart to the AIA.

Alternatively, it might be useful to think about space activities a bit differently from standard industrial definitions. A matrix might be applicable that permits not only a look at the industry from the perspective of combining the factors of production (land, labor, capital, and entrepreneurship) and selling hardware or services, but also from the perspective of the way the space sector functions. More specifically, it may be worthwhile to separate space activities into those performed terrestrially, those involved in accessing space, and those activities performed in space. In this way, some space activities would fit normal production processes; some would be classified as a transportation activity; and some would be separated out as uniquely operating in the environment of outer space, encompassing a host of analytical and policy issues different from other economic sectors.

Whatever approach might be taken to address data classification and definition issues, it would be necessary to recognize that the commercial space sector is relatively new and consequently less mature than many other industries in the U.S. economy. Space commerce is growing and changing rapidly, with new applications being introduced regularly. Some prove to be successful businesses, others not. Therefore, any new type of standards or definitions of space would have to be flexible and re-evaluated as the industry evolves.

The Role of Government

As noted earlier, the October 2001 workshop yielded comments suggesting that improvement in space economic data could be of considerable benefit to both the public and private sectors. Government policy and private investment decisions could be enhanced through greater data precision, reliability, and standardization. If clearer definitional boundaries of different space activities were also developed, data analysis would be considerably facilitated, whether using cross-sectional (using one time period) or time-series methodologies.

As space activity grows in the commercial world, the U.S. Government has a growing need to understand the relationship between government and industry, as well as between domestic and foreign activities, involving space. Good planning, both at the governmental level and for industrial investments, depends on accurate, timely, reliable, and usable data. The utility to the government of collection and dissemination of high-quality economic data has already been amply demonstrated in a number of other sectors of the U.S. economy. The Department of Commerce oversees many such efforts related to collection of industrial economic data, most notably through the activities of the Bureau of the Census and the Bureau of Economic Analysis.

Considering the space sector in particular, the government has a number of important reasons for working to maximize the quality of economic data.

- The government has both civil and defense space programs that require economic data for budget, impact, and environmental analyses to meet legislative mandates.
- Cost estimates must be developed for new and continuing space programs.
- Federal economic planning requires both an overall perspective on the economy and industrial-level data that are consistent across industries.
- A large part of the space program is R&D that constitutes one cornerstone of government efforts to stimulate competitiveness and economic growth.
- The increasing importance of government/industry partnerships requires a large amount of current and accurate economic data to analyze the value of the partnership agreement.

Because the government has not accorded the space sector the kind of inclusion in on-going national income accounting given to many other industrial sectors, much of the information that might facilitate government space-related decision-making is simply unavailable. In determining the appropriate government response to the current state of affairs, it appears advisable to consider the extent to which there is a legitimate need for:

- 1) standards for data classification and quality,
- 2) comprehensive, industry-wide data collection on a continuous basis, independent of any temporary situational need or proprietary interest, and
- 3) easy access to publicly available data.

In addressing such needs, three levels of government initiative might be conceptualized.

- Preserving the present state of affairs would involve the government maintaining its current level of space economic data collection and dissemination, leaving public and private sector data users to collect any additional needed data or purchase it from one or more private firms.
- A more active option would involve the government maintaining its current level of space economic data collection and dissemination, but also assuming a new role of setting uniform standards for quality of existing government-generated space economic data sets, as well as publishing these government-generated data in a comprehensive format.
- Still more active would be for the government, in addition to setting quality standards for data it currently collects and comprehensively publishing these data, to further expand its data role by formally creating a newly-defined space sector (including both industry and government activity) in the national income accounts. Such an initiative would involve clearly establishing needs, developing standard definitions, surveying firms, and incorporating the data in the Census of Manufactures and/or in GDP, Input-Output, employment, productivity, and other publicly available databases produced by the various government statistical agencies. Parallel with this expansion of the government role in data collection might be government encouragement of private data sources to agree on voluntary standards for data quality, with the aid of one or more non-governmental standard-setting organizations (e.g., the American National Standards Institute - “ANSI”).

In the third alternative described above, the government role would be that of a producer of standardized and comprehensive space economic data, calibrated to and with other national income accounts where appropriate.¹⁰ In such a scenario, both public and private sector entities would remain free to process these raw data for their own particular purposes, including making

¹⁰ Some economic information such as tracking launches and payload values, as is now performed by the DOT/FAA, would fall outside of this initiative but would still remain a valuable source of additional information about space activity.

predictions about future activity. In effect, the government role in collection of raw data would become just as routine in the space sector as in other industrial sectors, where active government data collection has long been considered the norm.¹¹ Clearly, industry will have to enter into a partnership with the government for this to be successful. It will be necessary for the space industry to actively support the need for government data collection, to provide the necessary information in new surveys, and possibly to jointly fund some data collection efforts.

¹¹ Given that so many space data sets are produced today on a case-by-case basis by both government and industry to advocate particular programs, more comprehensive and continuous data collection and publication could render the process of debating future initiatives less adversarial and more balanced. No one would be precluded from producing additional information beyond that included in the standard government data collection protocol, but at least there would be a common, objective benchmark to help put independently produced information in perspective.



Recommendations

Developing measures of economic activities is an imperfect science. There is no perfect data set, and statistical compilations are only best estimates of economic activity. Each user of the data will have different needs and therefore will have a different viewpoint on measurements. However, through careful assessment of needs and appropriate use of available institutional and methodological tools, the value of quantitative economic measurement can be maximized.

Any attempt to improve economic data quality must face the fact that utility of the data depends on consistent collection over an extended period of time. Consequently, the benefits of improved data practices will only begin to emerge after a new approach has been in place for a number of years.

This realization underlines the importance of acting without delay to take advantage of opportunities to improve the quality of space-related economic information. With this goal in mind, the following recommendations present a pragmatic approach to developing an expanded data dialogue, an improved data inventory, clearer data definitions, broader agreement on data quality standards, and easier access to data sources.

Recommendation 1: Establish an on-going dialogue involving government, industry, academia, not-for-profit, and international space economic data producers and users.

The DOC should facilitate expansion of the dialogue initiated at the October 16, 2001 workshop, involving both public and private sector individuals and organizations in consideration of:

- the current state of space economic and business data,
- possible improvements, including new data series,
- a definition or set of definitions of space for data collection and dissemination purposes,
- approaches to establishment of data standards,
- options for development of regional economic models and specialized data collection instruments to facilitate U.S. state and local policy and planning efforts, and
- potential for international agreement on standards and definitions for space economic data.¹²

Recommendation 2: Develop an inventory of existing government data on space economic and business activities.

Within the U.S. Government, civilian space activities are focused in NASA and defense space missions in the DOD. However, many other agencies directly and indirectly fund space activities. Even within a Department such as the DOD, space programs span across the services and other divisions. It is currently impossible to identify, categorize, and analyze the funding characteristics of these programs by type of activity, industrial components, product codes, research disciplines, and employment characteristics on a cross-agency/program basis. Even evaluating the contractual relationships between government agencies and private industry (including academic and non-profit entities) is difficult.

¹² Active efforts are now underway in other nations to collect data on space activities. Each different survey employs slightly different definitions and standards, which makes international comparisons difficult. Yet space is a global industry, and the future growth of commercial and government space programs is likely to involve more multinational partnerships and joint ventures than at present. A list of U.S. Government agencies with potentially significant contributions to an international data dialogue would at least include the DOC, the Department of State, the National Science Foundation, NASA, and the FAA. In an area such as space data, where all nations face similar collection and analytical problems, the U.S. should take the initiative in working with other nations to explore possibilities for establishing standard definitions and publication formats. The DOC, as the major statistical agency for industry data in the U.S. Government, should play an important coordinating role. In addition to national governments with space programs, multinational entities such as the European Space Agency, the European Union, the United Nations, and the Organization for Economic Cooperation and Development could contribute to this process.

DOC should invite other government agencies to consider ways to improve coordination of the various publicly available sources of government information on space activities.

Potential advantages of this strategy are:

- a set of uniform definitions of government space activities and funding would be created, enabling strategic planning and analysis of space programs, and
- better cost analysis of space programs would enable more accurate evaluation of current and future space initiatives.

Potential challenges in implementing such an approach are:

- cost of coordination, data collection, maintenance of a data system, and
- difficulty effectively obtaining and organizing inputs from many different government agencies.

If creating an all-government effort is not feasible within the limits of available resources, the DOC could start the process by initiating an internal program to coordinate space government and industry data available solely within the Department. The DOC has responsibility for multiple data programs, including those of the Bureau of the Census, the Bureau of Economic Analysis, the National Oceanographic and Atmospheric Administration, the Bureau of Industry and Security, the International Trade Administration, the National Institute of Standards and Technology, and the Office of Space Commercialization. These activities span both the space sector *and* the general collection and reporting of national income data. Therefore, an effort solely within the DOC to develop definitions of space activities and integrate them with industrial classification efforts could be undertaken.

Such an initiative would also assist personnel in the Bureau of the Census who are continuously exploring new industrial designations for the NAICS. There is both a short-term and long-term opportunity to make a case for the inclusion of separate codes for some of the larger (in terms of

economic value) space activities. The creation of new codes for the NAICS is a continuous process, and currently the Bureau of the Census is looking forward to the next round of designations. As noted earlier, because it would be a number of years before cumulative space economic data generated within the new categories would be available in the income and product accounts, it would be important for the process to start as soon as possible. The process should be a cooperative one between the DOC and industry, and the DOC could work with an industry organization such as AIA to recommend candidate space sectors to the NAICS process.

Potential advantages of this strategy are:

- greater ease of coordination when dealing with only a single agency,
- reduced cost, in comparison to full interagency coordination, and
- benefit from DOC expertise in statistical data collection and reporting.

Potential challenges in implementing such an approach are:

- difficulty of coordination, even within a single agency,
- cost borne by DOC alone, and
- continued release of data by other government agencies using different definitions and classification systems.

Recommendation 3: Encourage development of clear definitions of space activities and standards for space economic data quality.

DOC should encourage existing standards organizations (e.g., ANSI) to explore development of definitions and standards for space economic data. Recognizing that different users and methods

may have a wide variety of special requirements for data, the fact remains that a major problem in interpreting existing data on space economic activity is the lack of uniformity in industry definition and in the classification of many space and space-related activities. Groups such as ANSI are able to consult both private and public sector stakeholders and experts in an effort to help ensure that standards reflect a broad range of views and gain wide acceptance.

The following is a suggested list of the types of issues that might be considered in setting standards for data quality:

- An objective and unbiased party should collect data.
- The survey instrument and other relevant, non-proprietary, source material should be publicly available.
- Significant statistical parameters should be made available with the data. These would include the sample size, how the sample was selected, the number of complete returns, and any estimating routines employed.
- A clear definition of all terms and of what is to be included by the respondents to the survey should be part of the survey instrument.
- The date when the data were collected and the dates the information covers should be clear.
- The rules for handling data disclosure problems and confidentiality of data should be clearly defined.
- Similarly, the procedure for handling classified government data should be outlined.
- A clear explanation of exchange rate and other relevant assumptions should be included with foreign data.

Recommendation 4: Develop effective methods for improving access to space economic data, and explore the feasibility of a central, publicly-accessible electronic warehouse.

An extensive, up-to-date catalogue of both government and privately-generated data on space economic activity would be a very useful tool for analysis and planning. The DOC should therefore facilitate establishment of a publicly-accessible clearinghouse for such information, with participation on a voluntary basis by both government data-generating agencies and private data-producing organizations. The clearinghouse could take the form of an Internet-based “portal” with links to external sites where the data actually reside. Lessons relevant to this kind of portal’s design might be drawn from the Global Information Locator Service (GILS), reviewed by Eliot Christian of the U.S. Geological Survey (USGS) at the October 16, 2001, DOC workshop on space economic data (viewable at the DOC Office of Space Commercialization website, which at the time of publication of this report is located at <http://www.ta.doc.gov/space/>). The extent to which a clearinghouse would include description of data quality would depend both on the degree of agreement achieved on quality standards (see Recommendations 3 above) and the amount of data quality information that clearinghouse participants would choose to provide.

Potential advantages of this strategy are:

- requires minimal funding,
- provides a guide to users of the data, and
- affords an opportunity for publishing data.

Potential challenges in implementing such an approach are:

- explaining that government facilitation of access to sources of data does not involve certification of data quality or usefulness,

- clarifying that data access is not comprehensive, because participation by data source organizations is voluntary,
- devoting staff time to management and updating of the clearinghouse, and
- dealing with copyright issues that may limit access to some private data sources.

VI

Additional Options

Two additional options, one at each end of the spectrum, are discussed below.

Maintaining the Status Quo

This is a default option that always exists. However, as the body of this report indicates, many experts and analysts of space activities favor steps to improve the availability and quality of space economic data. And as the commercial space sector continues to develop and mature, space activities will increasingly become the focus of analysis. Recognizing that the industry is now very different than it was in the era of government-only space programs may pave the way for the government to analyze the space sector just as other commercial sectors are evaluated. Furthermore, the government has a need for better space economic data in its own strategic planning, budgeting, and policy functions. Similarly, space investments in the financial world must be compared in risk and return on investment (ROI) to other private investments. Having comparable data may decrease the perception of risk of investment opportunities in space-related projects and thereby help increase the amount of future private investment in commercial space. Taking steps to improve the data may also facilitate more informed public and private sector decisions, particularly when new space initiatives require partnership arrangements between government and commercial industry.

Full-Scale Effort to Develop an Accurate Measurement System

At the opposite end of the spectrum would be government commitment to a full-scale effort to create a system that would ensure a consistent, reliable, and continuous stream of data on the space sector. There might be at least five components of such an effort:

- 1) Facilitating development of standards of data quality and standard definitions of space activities.
- 2) Creating a unified set of government (across agency) accounts that detail space activities on budget and outlays (expenditures) for each year.
- 3) Creating a set of data on the space sector that would effectively separate the reporting of space-related activities by industry from other industrial products and services. These data would be an integral part of industrial classification (NAICS) efforts and eventually would be part of all national income accounting data, including input-output tables, price indices, employment, productivity, and other routinely reported industrial statistics. Budget line-items would have to be created in the various statistical agencies (DOC/Census, BEA, BLS, etc.) in order to accomplish this and to ensure continuity in the future.
- 4) Initiating a new measurement program to develop a set of special indicators for the space sector. These could be organized in a number of ways and might include not only standard economic measures (as above), but also new surveys. Possible approaches are to develop leading and lagging indicators of space activity, input-output analyses of space sector impacts, and a regional geographic profile of space activities within the United States.
- 5) Just as the DOC published *Space Business Indicators* in the early 1990s, a new publication could be initiated that would be a compilation of existing data on space activities based on the information collected in the inventory stages.

Potential advantages of this strategy are:

- creation of a set of data on space activities that is consistent with other industries and that analysts can use with confidence,
- continuity of data series indefinitely into the future as part of routine government activity,
- development of an international standard—U.S. leadership in this area at an official level might well stimulate other nations to follow and adopt similar definitions,
- opportunity to develop valid and reliable statistical methodology, and
- higher response rate to government questionnaires than to privately sponsored surveys.

Potential challenges in implementing such an approach are:

- cost—such an effort would be expensive,
- complexity—even compiling a standard set of government program statistics on space activities, let alone statistics for industry and other sectors, would be a difficult endeavor, and
- coordination—effectively obtaining and organizing inputs of a wide variety of public and private sector entities would be difficult.

A full-scale government data initiative may be viewed as a long-term goal that is useful for policy discussion and strategic planning but may realistically be beyond the level of resources available in today's environment. It is also important to recall that even major improvements in statistical data methods and in reliable time series data collection can only gradually produce greater data utility. Any progress that can be made will be incremental and will be phased in over time. Therefore, initiatives to improve data on space activities will require a long-term commitment to a process of improvement. Policymakers should expect that an initiative this year would begin to yield results in

a minimum of two years. Substantially improved data on space may not become apparent for five to ten years. However, we must begin somewhere.

In conclusion, there is a wide range of actions available to improve space economic data. We have choices: either take an aggressive approach to reforming the data system or take incremental steps toward improvement. If we are to expect any reasonable change, we must begin to formulate and act on a process immediately. Each delay extends indefinitely the lack of knowledge that exists today about the space sector.

VII

**Appendix:
Space Economic Data Workshop**

As part of a joint agreement between the U.S. Department of Commerce, Office of Space Commercialization, and the Space Policy Institute at George Washington University, a workshop was convened on October 16, 2001, to discuss issues related to space economic data.

Agenda

Note: Most presentations from the workshop can be viewed at the DOC Office of Space Commercialization website, which at the time of the publication of this report is located at: <http://www.ta.doc.gov/space/>.

8:00 a.m.- 8:30 a.m. **Registration**

8:30 a.m.- 8:45 a.m. **Welcome & Remarks**

Bruce P. Mehlman,

Assistant Secretary for Technology Policy, U.S. Dept. of Commerce

Paul Eckert,

Office of Space Commercialization, U.S. Dept. of Commerce

Henry Hertzfeld,

Space Policy Institute, George Washington University

- 8:45 a.m.- 9:15 a.m.** **Workshop Introduction & Overview**
- Scott Pace,
Office of Science and Technology Policy, The White House
- 9:15 a.m.- 9:45 a.m.** **Data Classification**
- Jack E. Triplett,
The Brookings Institution
- 9:45 a.m.- 10:30 a.m.** **Lessons from Outside the Space Sector**
- Tourism: Sumiye Okubo,
Bureau of Economic Analysis, U.S. Dept. of Commerce
- Geospatial Data: Eliot Christian,
U.S. Geological Survey
- 10:30 a.m.- 10:45 a.m.** **Break**
- 10:45 a.m.- 11:15 a.m.** **International Data**
- Pierre Lionnet,
Eurospace
- 11:15 a.m.- 12:30 p.m.** **Public and Private Uses for Space Economic Data**
- Elaine Gresham,
Futron Corporation
- Kevin Leclaire,
SpaceVest
- Herb Bachner,
Federal Aviation Administration
- Bob Preston,
RAND Corporation

12:30 p.m.- 1:30 p.m.	Lunch
1:30 p.m.- 3:30 p.m.	Breakout Sessions <i>Data Collection and Access</i> <i>International Data</i>
3:30 p.m.- 4:00 p.m.	Reports from Breakout Groups
4:00 p.m.- 4:30 p.m.	Workshop Summary and Next Steps Paul Eckert, <i>Office of Space Commercialization, U.S. Dept. of Commerce</i> Henry Hertzfeld, <i>Space Policy Institute, George Washington University</i>

Selected Major Points

The principal question to be addressed was: “Are there worthwhile ways to improve space economic data, and if so, what are some options for improvement?” The workshop discussions suggested that, although much has been learned regarding effective measurement of space economic activity, and considerable information is already available, improvement is both possible and desirable.

Some significant points raised in presentations and discussions during the workshop include the following:

- Improved space economic data could facilitate government policy decision making.
- The space industry is not easily or fully identifiable in U.S. national income statistics; there are no current government plans to isolate space as a separate activity in future

industry classification systems. However, these classification systems are undergoing revision, and the possibility exists to work more closely with the Bureau of the Census to identify space activities that might qualify for inclusion.

- There are a variety of different views concerning what should or should not be included in the definition of a space industrial sector; no standard definition exists.
- Other economic activities such as “travel and tourism” pose similar definitional challenges. There have been limited attempts to create new analyses on a government level for some of these sectors, and these attempts may be relevant to future similar exercises for space.
- Given the very high level of industrial concentration in a few firms at the major systems integration level of space activities, data confidentiality will be an important issue to address in any proposed modification of Bureau of the Census data procedures.
- Government budget data are frequently published as either authorized or appropriated expenditures for a fiscal year. For many types of economic analysis, actual outlays are also an important measure of activity.
- The Defense Department currently spends more federal money on space than NASA and the other civilian agencies combined.
- The potential for double-counting must be carefully evaluated in interpreting space economic data, since government funds (often R&D) might also be included in industry sales totals.
- Corporate R&D in space is difficult to separate from R&D in many other areas, disciplines, and branches of research. This issue is particularly relevant to large multi-product conglomerate firms where space products are a relatively small component of total production.
- Accuracy of cost estimating could be improved for government space programs.
- Creating a mechanism for following the sales or renaming of different space objects would make it easier to track data on satellites and launch vehicles.

- Response rate is an important consideration in evaluation of space industry surveys.

- Reliability, validity, and accuracy are essential considerations in evaluating all economic data, whether publicly published by a government entity or privately distributed by a commercial firm.

- European users of space economic data would benefit as much as their U.S. counterparts from improvements in data collection and quality.

- International comparisons are complicated by exchange rate fluctuations and by the lack of standardized definitions, reporting techniques, and survey methods in different nations.



**U.S. DEPARTMENT OF COMMERCE
Office of Space Commercialization
Herbert C. Hoover Building
14th Street and Constitution Avenue, N.W.
Washington, D.C. 20230**

**Phone:
(202) 482-6125
(202) 482-5913**