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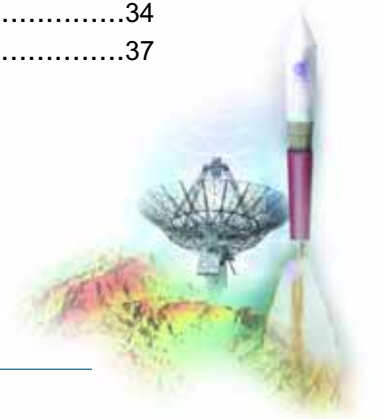


The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2004

February 2006

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Executive Summary

The Economic Impact of Commercial Space Transportation on the U.S. Economy is the latest study by the Federal Aviation Administration’s Office of Commercial Space Transportation (FAA/AST) of the commercial launch industry’s influence on the nation’s economy. It provides a quantitative analysis of the extent to which commercial space transportation and enabled industries together are responsible directly and indirectly for supporting a variety of space- and non-space-related industries, thereby contributing to production and generating jobs in the United States.

This report examines both the U.S. commercial launch industry and the associated industries it has enabled to calculate the full economic impact of commercial space transportation on the U.S. economy. These include launch vehicle manufacturing and services, satellite manufacturing, ground equipment manufacturing, satellite services, remote sensing, and distribution industries. This study outlines how those industries influence the economic activity, employee earnings, and number of jobs in all major U.S. industry sectors, as calculated by the U.S. Department of Commerce’s RIMS II economic model.

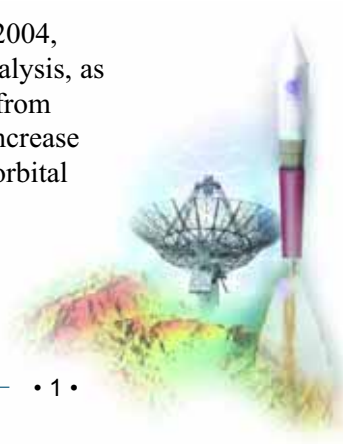
This study, the third performed by FAA/AST, shows that the economic impact of commercial space transportation on the U.S. economy continues to grow. In 2004, commercial space transportation and enabled industries generated a total of nearly \$98.1 billion in economic activity, over \$25 billion in earnings, and over 550,000 jobs. The chart below compares these results with the previous two studies, published in 2001 and 2004, which measured the economic impact of the same industries in 1999 and 2002 respectively. Economic activity increased in 2004 relative to both 2002 and 1999, with the exception of a slight decrease in employment from 2002 to 2004. This reduction is partially due to changes in the economic model, and is also due to increased automation, technological innovations, and outsourcing of components.

E1: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999, 2002, and 2004¹

Total Impact	1999	2002	2004
Economic Activity (\$000)	\$61,313,711	\$95,025,746	\$98,086,960
Earnings (\$000)	\$16,431,192	\$23,527,745	\$25,045,888
Jobs	497,350	576,450	551,350

While the economic impact of commercial space activities in general grew in 2004, performance was not uniform among the industry segments included in this analysis, as summarized on the following page. Launch vehicle manufacturing rebounded from 2002 because of an increase in commercial launches conducted in 2004. The increase in commercial launches includes the debut of the first commercial crewed suborbital

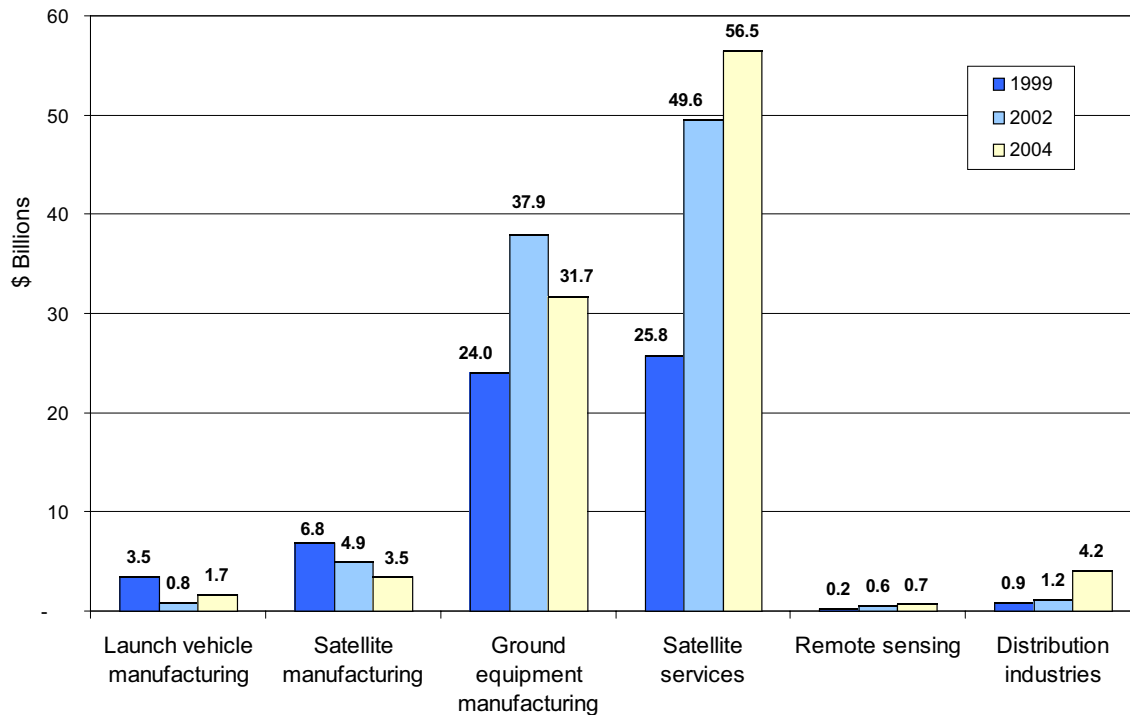
¹ Values shown are in current U.S. dollars, not adjusted for inflation.





launches of SpaceShipOne. However, these launches were developmental and therefore did not generate revenue. The satellite services sector continued its record of strong growth because of increased demand for direct-to-home (DTH) television services. Remote sensing and distribution industries also showed modest growth in 2004 over previous years. Combined, these industries were able to offset declines in economic activity in the satellite and ground equipment manufacturing sectors.

E2: Total Economic Activity Impacts on the U.S. Economy of Launch Enabled Industries for Years 1999, 2002, and 2004



Introduction

A U.S. commercial launch industry was born with the launch of the first commercial spacecraft, AT&T's Telstar 1, on a Thor-Delta booster in July 1962. The National Aeronautics and Space Administration (NASA) conducted the launch for AT&T on a cost-reimbursable basis. The U.S. government continued to support commercial space development by launching subsequent commercial payloads in the early space age.

The first U.S. commercial orbital launch licensed by the U.S. Government took place in August 1989 when a Delta 4925 carried the Sirius 1 communications satellite into orbit. Since that time, there have been more than 170 launches licensed by the U.S. Government. Today, four nations and one multinational entity have performed commercial launches.

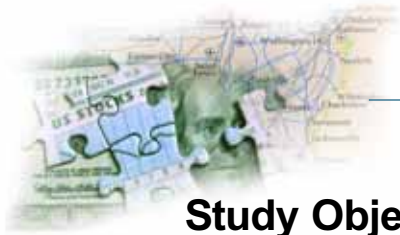
The development of a commercial space transportation industry has aided the growth of other industries. In addition to contributing to technological advancement, the launch industry has sparked economic growth by fostering the evolution of new commercial markets. The communications industry has gradually transformed its use of communications satellites from simple infrastructure applications such as telephone trunking and television transmission to more complex, value-added services including direct-to-home television (DTH), data services, very small aperture terminal (VSAT) services, and most recently, digital audio radio service (DARS). Commercial space transportation has also supported the growth of the commercial remote sensing industry. The growth of these satellite applications has, in turn, sustained markets for satellites and ground equipment.

Indeed, the launch industry has enabled satellite manufacturing, satellite communications services, remote sensing, and satellite ground equipment manufacturing. By producing reliable, more capable launch vehicles that successfully place satellites into orbit, the commercial space transportation industry has enabled the growth of markets for satellite services and satellite and ground equipment.

The Economic Impact of Commercial Space Transportation on the U.S. Economy is FAA/AST's latest study on the commercial launch industry's influence on the nation's economy. The commercial launch industry has promoted the development of businesses that build satellites, sell satellite communications services and satellite imagery, and manufacture ground equipment necessary to operate satellites and use satellite services. In this report, commercial space industries that depend on commercial space transportation are referred to as enabled industries. Responsible for billions of dollars of U.S. production each year, these industries are examined here in tandem with the commercial launch industry to assess the full impact of commercial space transportation on the U.S. economy.

This report is a quantitative analysis of the extent to which commercial space transportation and enabled industries together are responsible directly and indirectly for supporting a variety of space- and non-space-related industries, thereby contributing to production and generating jobs in the United States. The figures in this report do not simply present the revenues and employment statistics for the commercial launch industry and enabled industries. Rather, estimates derived from the data included in the report quantify the economic impact of the commercial launch industry and the industries it enables.





Study Objectives

Commercial space transportation and its enabled industries continuously impact the economy. This year's study aims to describe that impact by showing the economic impact of commercial space transportation² and the industries it enables on the nation's economy in 2004 by placing it in context with past economic environments.

The study highlights other industry sectors that profit from commercial space transportation activity and the extent to which these industries are affected. By measuring economic impacts, the study quantifies how much economic activity is stimulated, how much income is earned, and how many jobs are created in other industry groups as a result of the activities in commercial space transportation and enabled industries. This report highlights how the commercial space sector has tracked overall industrial trends toward more efficient manufacturing methods and emphasis on higher revenue-producing services.

In both 2001 and 2003, FAA/AST published studies of the U.S. commercial launch industry's effect on the nation's economy for the years 1999 and 2002, respectively. This report provides a comparison of the economic impacts of the commercial launch industry on the nation's economy in 2004 with the results from the two previous studies. It also compares the economic impacts of commercial space transportation and enabled industries to the impacts of other industry sectors on the U.S. economy.





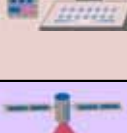

² This study classifies commercial launches as one or more of the following:

- Internationally competed launch events (i.e., launch opportunities considered available in principle to competitors in the international launch services market)
- Any launches licensed by FAA/AST under the *Commercial Space Launch Act* as amended, codified at U.S. Title 49, Subtitle IX, Section 701.

In some instances, commercial launches may include the launch of government payloads on commercial vehicles.

INDUSTRIES INCLUDED IN ANALYSIS

The industries included in the calculation of economic impacts are outlined below. The list comprises the commercial launch industry as well as the industries that commercial space transportation enables.

Industries Included in Analysis	
 Launch Vehicle Manufacturing and Services	Includes the construction of U.S. commercial launch vehicles and the provision of U.S. commercial launch services. ³
 Satellite Manufacturing	Includes the sale of all commercial satellites constructed by U.S. commercial satellite manufacturers.
 Ground Equipment Manufacturing	Includes satellite-related hardware, such as gateways and satellite control stations; mobile uplink equipment; VSAT terminals; and consumer electronics used with satellite services, such as direct broadcast satellite dishes, phone booths, and handheld phones.
 Satellite Services	Includes both end-user services and transponder leasing. End-user services include satellite telephony, VSAT services, satellite data services, and DTH. Satellite data services include mobile data services, such as asset tracking and high-speed Internet services. Transponder leasing includes services offered by companies that operate satellites and lease or sell satellite transponder capacity on a full-time or occasional-use basis.
 Remote Sensing	Includes the provision of raw satellite data and satellite imagery services. It does not account for sales by firms that digitally process imagery and combine it with additional information to create maps, databases, or other value-added products.
 Distribution Industries	Represent wholesale and retail trade margins and transit costs incurred as components are moved to manufacturing sites. Distribution industries are considered an additional enabled industry of commercial space transportation because truck, air, and rail transportation services are required to move parts to the manufacturing sites and to move launch vehicles and satellites to launch sites.

³ International Launch Services' Proton launches are not included in the impacts assessed herein. However, Sea Launch launches are included because Sea Launch is considered a U.S. company whose launches are both commercial and licensed by the FAA.





APPROACH

This study follows FAA-recommended procedures for economic impact analysis, including the use of the input/output method and the Regional Input-Output Modeling System (RIMS II) developed by the Department of Commerce, Bureau of Economic Analysis. The study uses FAA-accepted methods to quantify the economic values of financial transactions associated directly or indirectly with commercial space transportation and enabled industries. Financial transactions are traced through the economy in order to identify which industry types benefit, and by how much.

RIMS II is used to quantify the *full economic impact* of the commercial launch industry and the industries it enables; the figures herein do not simply present the revenues and employment statistics for the commercial launch industry and enabled industries. Economic impacts are measured in terms of economic activity (revenues), earnings of employees, and jobs generated not only within these industries but also within the industries they support directly and indirectly.

Commercial space transportation and enabled industries impact the national economy as well as regional and local economies across the country. In this report, commercial space transportation and enabled industries impacts are shown only for the national economy, with the understanding that the national economy is an aggregation of the regional economies throughout the United States.

RIMS II MODEL

RIMS II is a widely used and accepted economic input-output model developed by the Department of Commerce Bureau of Economic Analysis to map the flow of goods and services within the U.S. economy and to illustrate the interconnection of producers and consumers. The model is used to measure individual industries' contributions to the economy. Appendix A explains the way in which RIMS II was used to generate the data for this study. Appendix B elaborates the translation of the aforementioned industries into applicable categories for use with RIMS II.

Between 2002 and 2004 the RIMS II model underwent two major modifications that account for many of the estimated changes in revenues, earnings, and jobs impacts during this period. First, the industry coding system moved from Standard Industrial Classification (SIC) to the new North American Industry Classification System (NAICS). The NAICS system aggregates the earlier 38 SIC top-level industry sectors into 20 sectors, and reorganizes the *Manufacturing* sector. As a result, certain functions previously captured under manufacturing, such as publishing and management, have been reclassified under services. NAICS also recognizes a new *Information Services* sector. Because several activities have been moved out of the manufacturing sector, RIMS jobs multipliers for many manufacturing activities have consequently declined in comparison to 2002. This change has resulted in significant shifts in employment impacts, including decreases in manufacturing and increases in services.⁴

⁴ A detailed discussion of changes in the RIMS II industry classification system resulting from the shift from SIC to NAICS codes can be found at <http://www.naics.com/info.htm>.

Second, the 2004 RIMS II model is based on updated five-year national benchmark data. Use of more recent input-output statistics has improved accuracy of the model over its earlier versions, particularly regarding the contribution of distribution and utilities industries to total economic impact. These revisions reflect long-term trends in the U.S. economy, particularly the relative decline in manufacturing sector employment, and the shift towards greater service industry participation.

SOURCE DATA

Economic impact analysis using RIMS II is dependent on the revenue data for each industry analyzed. The revenue information used to derive the impacts shown in this report is based on the results of the Satellite Industry Association's (SIA) *2004 Satellite Industry Annual Indicators Study*.⁵ SIA has conducted an annual survey of hundreds of companies within the global space industry for the last eight years. The survey output is the total revenue of the commercial space industry, including the launch, satellite manufacturing, satellite services, remote sensing, and ground equipment sectors broken into U.S. and world revenue numbers.

This report considers only U.S. revenues and impacts of commercial launches and of the industries commercial space transportation enables. The data does not account for impacts on the economy of industries and activities enabled by Space Shuttle launches or non-commercial expendable vehicle launches, such as revenues from the launch of Global Positioning System (GPS) satellites and sales of handheld GPS navigation devices.

⁵ The data collected from the SIA survey have been recategorized to accommodate industry definitions determined to be appropriate for this report. Revenue data may differ from that reported by SIA.



Measuring Economic Impacts

The demand for commercial space transportation and enabled industries' goods and services impacts all other industry sectors. For purposes of this study, economic impacts are measured in terms of increases in economic activity (revenues), earnings, and jobs that occur throughout all industries in the national economy as a result of a change in final demand for products or services offered by commercial space transportation and the enabled industries.⁶ Following are the definitions for each type of impact:

- **Economic activity** is the value of goods and services produced in an economy. In this study, economic activity includes the goods and services produced by commercial space transportation and enabled industries plus the goods and services produced by all other industry groups to support the above industries.
- **Earnings** refer to the sum of all the wages and salaries (including employee benefits) paid to employees in an economy. In this study, earnings include wages and salaries paid to all persons employed by commercial space transportation and enabled industries, plus those employed by all other industry groups to support the above industries.
- **Jobs** refer to the number of workers employed to produce goods and services in an economy. In this study, jobs include all workers employed by commercial space transportation and enabled industries, plus those employed by all other industry groups to support the above industries.

The total economic impact of commercial space transportation and enabled industries in 2004 is summarized in Figure 1. Commercial space transportation was responsible for \$98 billion in economic activity in 2004, including \$3.5 billion generated by the manufacture of satellites and \$31.7 billion from the manufacture of ground equipment. Satellite services generated a total of \$56.5 billion in economic activity. Direct-to-Home (DTH) was by far the largest contributor, accounting for almost 90 percent of the economic activity impacts attributable to all satellite service industries. Distribution industries were responsible for economic activity of \$4.1 billion because of commercial space transportation and other enabled industries.

As a result of economic activity in the commercial space transportation and enabled industries, employees in all industry groups earned a total of \$25 billion in salaries and wages. Commercial space transportation and enabled industries stimulated over 550,000 total jobs throughout the economy.

⁶ The same economic impact is measured in three ways, which are differently denominated. Therefore, the impacts cannot be added together.

Figure 1: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 2004

Industry	Economic Activity (\$000)	Earnings (\$000)	Employment (Jobs)
Launch vehicle manufacturing	\$1,658,384	\$437,674	8,870
Satellite manufacturing	\$3,466,111	\$846,843	17,820
Ground equipment manufacturing	\$31,668,782	\$7,737,343	162,820
Direct-to-Home (DTH) TV Services	\$49,920,750	\$12,868,350	288,850
VSAT services	\$2,307,690	\$592,290	13,450
Data services	\$769,230	\$197,430	4,490
Transponder leasing	\$2,717,946	\$697,586	15,840
Mobile satellite telephony	\$743,589	\$190,849	4,330
Remote sensing	\$681,199	\$237,705	5,700
Distribution industries	\$4,153,278	\$1,239,817	29,180
Total Impacts	\$98,086,960	\$25,045,888	551,350

Each measure of economic impact described above is comprised of three components:⁷

- **Direct impacts** are the expenditures on inputs and labor involved in the provision of any final good or service relating to the industries analyzed herein.
- **Indirect impacts** involve the purchases (e.g., silicon, copper wire) made by and labor supplied by the industries that provide inputs to the launch and enabled industries. This impact quantifies the inter-industry trading and production necessary to provide the final goods and services.
- **Induced impacts** are the successive rounds of increased household spending that result from the direct and indirect impacts (e.g., a launch vehicle engineer’s increased spending on household goods and services).

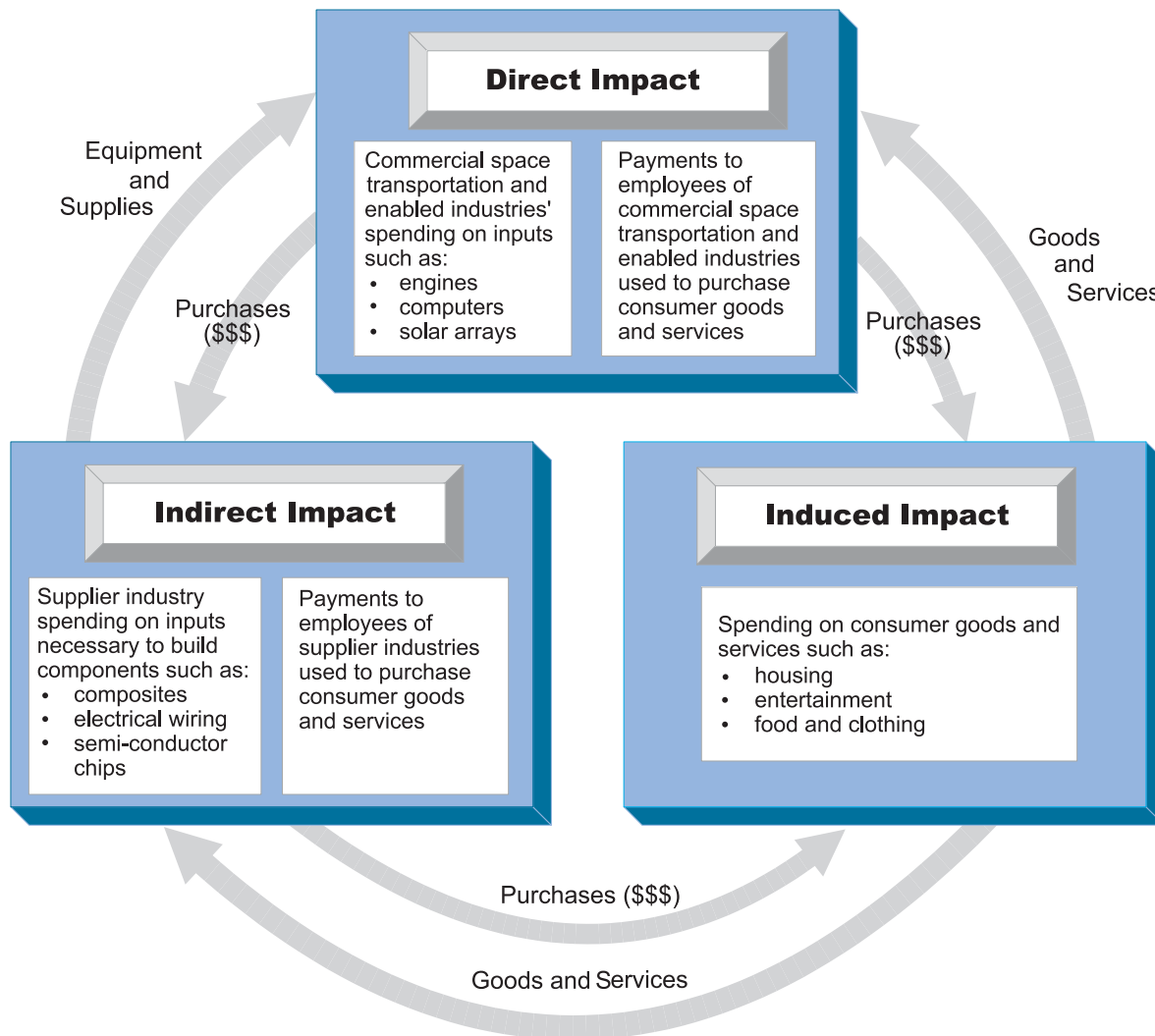
The output of the commercial space transportation and enabled industries yields direct impacts, which in turn result in indirect and finally induced impacts. As shown in Figure 2, demand for commercial space transportation results in payments to workers, including personnel working for launch service providers, steelworkers that provide materials for launch vehicles and satellites, and food service employees that feed all of these workers. Workers then re-spend these payments in local economies.

⁷ The direct, indirect, and induced components are computed only for economic activity in this report. The economic model used in this analysis does not make these distinctions for earnings and jobs.





Figure 2: Relationship of Impact Types



Economic Activity

This section of the report includes the economic activity impacts of commercial space transportation and enabled industries in 2004. Figure 3 illustrates the total economic impacts generated by commercial space transportation and enabled industries. The table details the direct, indirect, and induced impacts of economic activity. Added together, the direct, indirect, and induced impacts yield the total impact on the U.S. economy.

Figure 3: Economic Activity Impacts of Commercial Space Transportation and Enabled Industries, 2004 (\$000)

Industry	Direct	Indirect	Induced	Total Impacts
Launch vehicle manufacturing	\$286,936	\$759,171	\$612,277	\$1,658,384
Satellite manufacturing	\$626,307	\$1,654,746	\$1,185,058	\$3,466,111
Ground equipment manufacturing	\$5,722,370	\$15,118,905	\$10,827,507	\$31,668,782
Satellite services	\$9,428,956	\$26,684,009	\$20,346,240	\$56,459,205
Remote sensing	\$69,529	\$279,196	\$332,474	\$681,199
Distribution industries	\$532,049	\$1,886,862	\$1,734,366	\$4,153,278
Total Impacts	\$16,666,148	\$46,382,890	\$35,037,924	\$98,086,960

Purchases of inputs from supplier industries are captured in the indirect impact and employees' household spending is captured in the induced impact. The indirect and induced impacts of an industry tend to be larger than the direct economic impact, because the value of the components is often greater than the value added in the production of the final goods and services. For the service industries, the largest investment is often in the salaries of the workers needed to provide the service.

Figure 4 shows the relative proportion that each of the six industry groups analyzed contributed to total economic activity impacts in 2004. Satellite services and ground equipment manufacturing contributed the largest portions of this activity, comprising 58 percent and 32 percent, respectively, of the total impact.

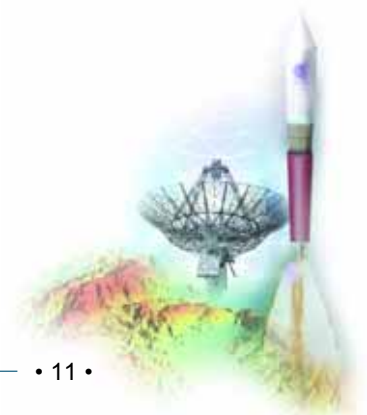
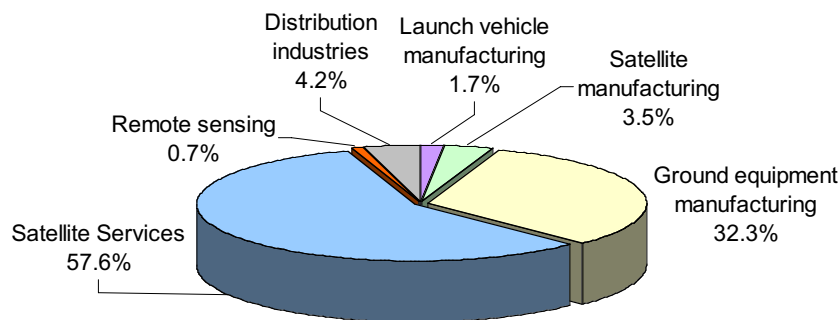




Figure 4: Distribution of Total Economic Activity Impacts Resulting from Commercial Space Transportation and Enabled Industries, 2004



The results suggest that the launch vehicle manufacturing and services industry primarily functions in the economy as an enabler of other industries. Over time, commercial launches have placed many satellites in orbit that have allowed operators to offer a range of satellite services and have spurred the growth of ground equipment production to support these satellite services. Therefore, although the impacts of launch vehicle manufacturing and services in 2004 were small, the industry has successfully fueled the continuous achievements of other industries. Commercial launch is essential for the maintenance of existing satellite services markets and is invaluable for future emerging space markets.

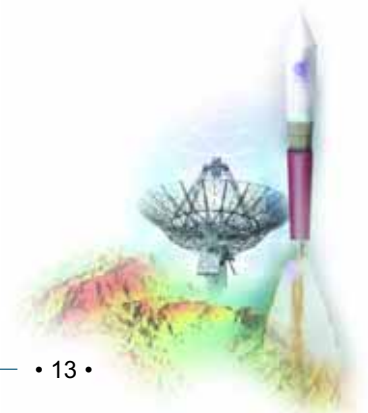
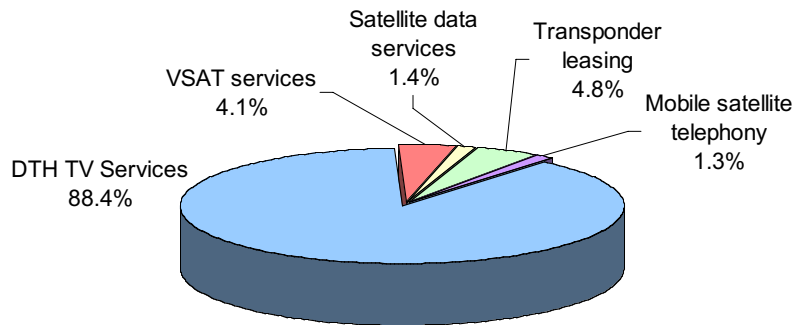
ROLE OF GOVERNMENT IN SPACE TRANSPORTATION

The federal government continues to play a critical role supporting the U.S. commercial space transportation industry as both a customer and an investor. In 2004, 10 of the 16 launches of U.S.-built expendable launch vehicles (ELVs) carried U.S. government payloads: six for the Defense Department and four for NASA. The total estimated value of those launches was approximately \$975 million. Many of these launches took place using launch vehicles that are also available for commercial launches. Thus, government purchases of launch services provide a key source of revenue for launch vehicle companies, particularly during a continued period of depressed commercial demand for launch services.

The government has also helped develop the current generation of commercial launch vehicles. The Defense Department's Evolved Expendable Launch Vehicle (EELV) program led to the development of two launch vehicles, the Delta 4 and Atlas 5, which have been used for both commercial and military customers. To aid in the initial development of these vehicles, the Air Force provided \$500 million to each company when it awarded the initial EELV launch contracts in 1998. More recently the Air Force has provided additional money to support EELV engineering and vehicle reliability projects at the two companies to help compensate for the loss of commercial launch revenue. The government also supports the launch industry by building and maintaining launch facilities, including the Cape Canaveral Air Force Station in Florida and Vandenberg Air Force Base in California, that are used for both government and commercial launches.

A further breakout of the satellite services portion of economic activity impact is shown in Figure 5. DTH was by far the leading satellite service, accounting for 88 percent of the economic activity generated in 2004. Transponder leasing was the next largest contributor, with five percent of the total satellite services impact. VSAT services, data services, and mobile satellite telephony comprise the remaining six percent of the total economic activity impact due to satellite services.

Figure 5: Distribution of Economic Activity Impacts Resulting from Satellite Services Industry Segments, 2004





Most Affected Industries

All major U.S. industry sectors are affected by the activities of the commercial space transportation and enabled industries to some extent.⁸ Figure 6 shows how each of the industry groups was impacted in terms of economic activity, earnings and jobs as a result of the commercial space transportation and enabled industries in 2004. The industry groups are ranked by the extent of impact on economic activity. Although some of these industry types seem unrelated to commercial space transportation, they appear because they provide goods and services, directly or indirectly, to the commercial space industry. All of these industry groups benefit from the re-spending of money on consumer goods, such as household items and leisure activities.

In 2004, the *information services* sector was the most affected sector in terms of additional economic activity, earnings, and jobs, generating over \$29.5 billion of revenues, nearly \$7 billion in earnings, and creating approximately 117,000 jobs. Some information services which directly or indirectly provide inputs to the commercial space transportation and enabled industries include data processing, web and application hosting, and related services; Internet Service Providers; Internet publishing and broadcasting; newspaper, magazine and book publishing; software publishing; and film, television and video production and distribution.

Manufacturing ranked second with an increase of \$27.4 billion in economic activity and over 87,000 jobs. This sector includes the manufacture of a wide range of products such as machinery, computer and electronic devices and components (semiconductor microprocessors and integrated circuits, for example), electrical equipment and appliances (e.g. motors and generators), motor vehicles, food and beverages, textiles and apparel, and paper and plastics.

Finance and insurance generated \$4.7 billion in economic activity and some 22,600 jobs. Some financial services which directly or indirectly provide inputs to the commercial space transportation and enabled industries may include commercial and savings banks; credit unions and student loan firms; mortgage and home equity credit lenders; pension fund managers; securities brokerages and underwriters, and venture capital firms. Examples of insurance services, which may be similarly directly or indirectly affected, encompass insurance agencies and brokerages, and claims adjusting and actuarial services.

The *health care and social assistance* segment experienced an increase of \$3.4 billion in economic activity and nearly 45,000 jobs due to final demand generated by the commercial space transportation sector and enabled industries. This segment includes medical and dental labs; doctor, dentist, physical therapist and paramedic offices and practices; home nursing and hospice care services; hospitals and HMO clinics; and ambulance services, for example.

⁸ RIMS II defines the “major” U.S. industry sectors, all of which appear in Figure 6. The reduced number of industry groups shown, 19 here compared to 37 shown in the 2004 FAA AST report, reflects changes in the industry classification methodology employed by the Department of Commerce. See discussion under Study Objectives.

Figure 6: Distribution of Economic Activity, Earnings and Jobs throughout Major U.S. Industry Sectors, Generated by Commercial Space Transportation and Enabled Industries, 2004

Industry Group	Economic Activity (\$000)	Earnings (\$000)	Jobs
Information Services	\$29,575,613	\$6,925,965	116,800
Manufacturing	\$27,439,628	\$5,197,419	87,820
Real Estate and Rental and Leasing	\$6,571,523	\$489,710	15,250
Finance and Insurance	\$4,776,096	\$1,317,897	22,600
Wholesale Trade	\$4,686,286	\$1,505,865	28,830
Professional, Scientific, and Technical Services	\$4,159,086	\$1,820,678	34,260
Health Care and Social Assistance	\$3,482,882	\$1,695,749	44,720
Retail Trade	\$2,963,727	\$1,007,239	43,160
Transportation and Warehousing	\$2,331,069	\$809,103	19,620
Other Services	\$2,072,797	\$686,853	25,080
Accommodation and Food Services	\$1,777,420	\$680,127	31,540
Management of Companies	\$1,761,363	\$870,109	12,080
Administrative and Waste Management Services	\$1,600,600	\$675,357	27,300
Arts, Entertainment, and Recreation	\$1,364,960	\$525,651	19,330
Utilities	\$1,292,394	\$240,149	2,850
Agriculture, Forestry, Fishing, and Hunting	\$881,254	\$128,289	5,840
Educational Services	\$557,315	\$251,320	9,790
Mining	\$456,971	\$90,606	1,270
Construction	\$335,976	\$127,801	3,220
TOTAL	\$98,086,960	\$25,045,887	551,360

The *construction* sector was the least affected industry sector. Nonetheless, due to commercial space transportation and the enabled industries, it benefited from an additional \$336 million of economic activity and about 3,200 new jobs. Construction activities which directly or indirectly support the commercial space transportation sector may include the building of single-family and multifamily homes, factories and mills, warehouses and office buildings, shopping centers, health and athletic clubs, and sewage treatment plants.

JOB IMPACTS

A comparison with total job impacts in previous years reveals a slight decrease in employment over all affected industries, from 576,448 in 2002 to 551,360 in 2004, in contrast to a 3.2 percent increase in total economic impact over this period. Of the top five affected industries, in terms of job impacts, services and manufacturing remained the leading two affected sectors, while the third through fifth sectors changed from 2002 to 2004 (see Figure 7).





Figure 7: Top Five Affected Industries, Ranked In Terms of Total Job Impacts, 2002 and 2004

2002	2004
Services	Services
Manufacturing	Manufacturing
Utilities	Retail Trade
Retail Trade	Wholesale Trade
Wholesale Trade	Finance and Insurance

Services showed the greatest gain in estimated employment over this timeframe, largely due to continued substantial growth in revenues for satellite services, particularly DTH, but also as a result of a general shift towards the service sector in the US economy. Manufacturing evidenced a loss of jobs as a partial result of a decline in satellite and ground equipment manufacturing activity. Changes to the RIMS II model, including reclassification of certain manufacturing activities as services and updates to the underlying input-output data, are also reflected in these employment shifts between sectors (see discussion under Study Objectives).

ECONOMIC IMPACTS OF THE LAUNCH VEHICLE MANUFACTURING SECTOR

The launch vehicle manufacturing sector contributes \$1.6 billion in economic activity and approximately 8,900 jobs, or less than two percent of the total economic activity and jobs generated as a result of the commercial space transportation industry and related enabled segments. Several of the various industries that are directly and indirectly affected by launch vehicle manufacturing are profiled in Figure 8.

In 2004, the *manufacturing* sector was by far the most affected industry in terms of additional economic activity, earnings, and jobs generated due to launch vehicle manufacturing, producing about \$951 million of economic activity, more than \$211 million in earnings, and creating approximately 3,000 jobs. This constituted 57.3 percent of total economic activity and 34.3 percent of total jobs attributable to this sector. Once again, construction was the least affected secondary industry, benefiting from an additional \$6.4 million of economic activity and about 60 new jobs due to launch vehicle manufacturing and related enabling industries.

Figure 8: Industries Most Affected by Launch Vehicle Manufacturing Sector, 2004

Industry Group	Economic Activity (\$000)	Earnings (\$000)	Jobs
Manufacturing	\$951,198	\$211,907	3,040
Real Estate and Rental and Leasing	\$94,421	\$6,118	220
Finance and Insurance	\$80,345	\$22,360	380
Professional, Scientific, and Technical Services	\$70,762	\$31,889	570
Health Care and Social Assistance	\$60,854	\$29,615	780
Wholesale Trade	\$52,246	\$16,784	320
Retail Trade	\$50,567	\$17,163	740
Information Services	\$46,074	\$12,723	230
Management of Companies	\$45,207	\$22,306	310
Transportation and Warehousing	\$44,774	\$14,889	360
Accommodation and Food Services	\$30,914	\$11,803	550
Other Services	\$30,644	\$10,124	370
Administrative and Waste Management Services	\$25,933	\$10,828	430
Utilities	\$23,876	\$4,385	50
Agriculture, Forestry, Fishing, and Hunting	\$15,214	\$2,220	100
Mining	\$10,124	\$2,003	30
Educational Services	\$9,420	\$4,277	170
Arts, Entertainment, and Recreation	\$9,366	\$3,844	160
Construction	\$6,443	\$2,436	60
TOTAL	\$1,658,384	\$437,674	8,870





Figure 9 shows the top input activities to launch vehicle manufacturing for four major industry sectors (manufacturing, services, transportation and warehousing, and “other”). These sectors are ranked in order of importance, with “other” constituting a collection of activities embracing wholesale and retail distribution, utilities, construction, extraction industries and government. Manufacturing suppliers accounted for 71 percent of total launch vehicle manufacturing inputs. Sectors providing major inputs here included semiconductor and related device manufacturing, gasket and metal valve manufacturing, and forging and stamping industries.

Another important facet of launch vehicle manufacturing activity is supply chain management (SCM), which generates the bulk of direct economic activity, earnings and job impacts. SCM refers to the collection of enterprise business processes associated with the purchase of materials and services employed as inputs in the production of launch vehicle equipment. SCM is an information processing-intensive activity, and relies heavily on the use of information technology such as software systems.

Categories of supplier purchases generally encountered in the launch vehicle manufacturing industry include primary and secondary inputs such as raw materials (metal, for example); semi-finished products and components (structures); finished products (engines, sensors and electronics); maintenance, repair and operating items; production support items (oil, grease, utilities); services (legal, financial, engineering, environmental, for example); capital equipment (milling machines, assembly stands); and transportation and third-party logistics.

The launch vehicle manufacturing supply chain is composed of a descending hierarchy of manufacturing and services suppliers which purchase subsystems, major components, items, raw materials, services, transportation and warehousing, and other goods and services from firms farther down the chain in a “trickle-down effect” (see Figure 10). The totality of economic impacts results from revenues and jobs generated at each level of the supply chain hierarchy as well as from associated household spending at each level.

Services constituted the second major category of industries affected by launch vehicle manufacturing final demand, contributing 20 percent of total direct inputs. Leading services sector contributors encompassed enterprise management, professional and technical services such as architecture and engineering, data processing and telecommunications services, real estate, securities and investment management services, and food services.

Transportation and warehousing make a relatively small contribution to the total direct inputs to the launch vehicle manufacturing industry (three percent), and comprise a similarly small share of the related total economic impact. Leading contributing industries here include air transportation, warehousing and storage, water and pipeline transportation, and postal services.

Other sectors provided the remaining inputs to the launch vehicle manufacturing industry, and constitute a small share of the total. Major contributing activities range from wholesale trade, utilities such as power generation and supply, government organizations, oil and gas extraction, coal mining and retail trade.

Figure 9: Top Direct Input Activities to Launch Vehicle Manufacturing, by Major Industry Sector ⁹

Industry Sector	Share of Inputs (Total Sector)	Top Subsectors, in Rank Order
Manufacturing	71%	Propulsion units and parts for space vehicles and guided missiles Guided missile and space vehicle manufacturing Semiconductors and related device manufacturing Machine shops Search, detection, and navigation instruments Gasket, packing, and sealing device manufacturing Metal coating and nonprecious engraving Metal valve manufacturing All other forging and stamping Electroplating, anodizing, and coloring metal
Services	20%	Management of companies and enterprises Scientific research and development services Architectural and engineering services All other miscellaneous professional and technical services Data processing services Telecommunications Real estate Nondepository credit intermediation and related activities Securities, commodity contracts, investments Food services and drinking places
Transportation and Warehousing	3%	Air transportation Warehousing and storage Truck transportation Rail transportation Couriers and messengers Scenic and sightseeing transportation and support activities for transportation Transit and ground passenger transportation Water transportation Pipeline transportation Postal service
Other	6%	Wholesale trade Power generation and supply Construction Natural gas distribution Other government enterprises Oil and gas extraction Coal mining Retail trade
Total All Sectors	100%	

⁹ Based on RIMS II Model, I-O Commodity Composition of Intermediate Purchases, Guided Missiles and Space Vehicle Manufacturing, NAICS 336414.

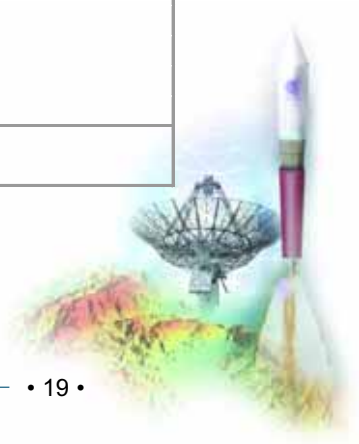
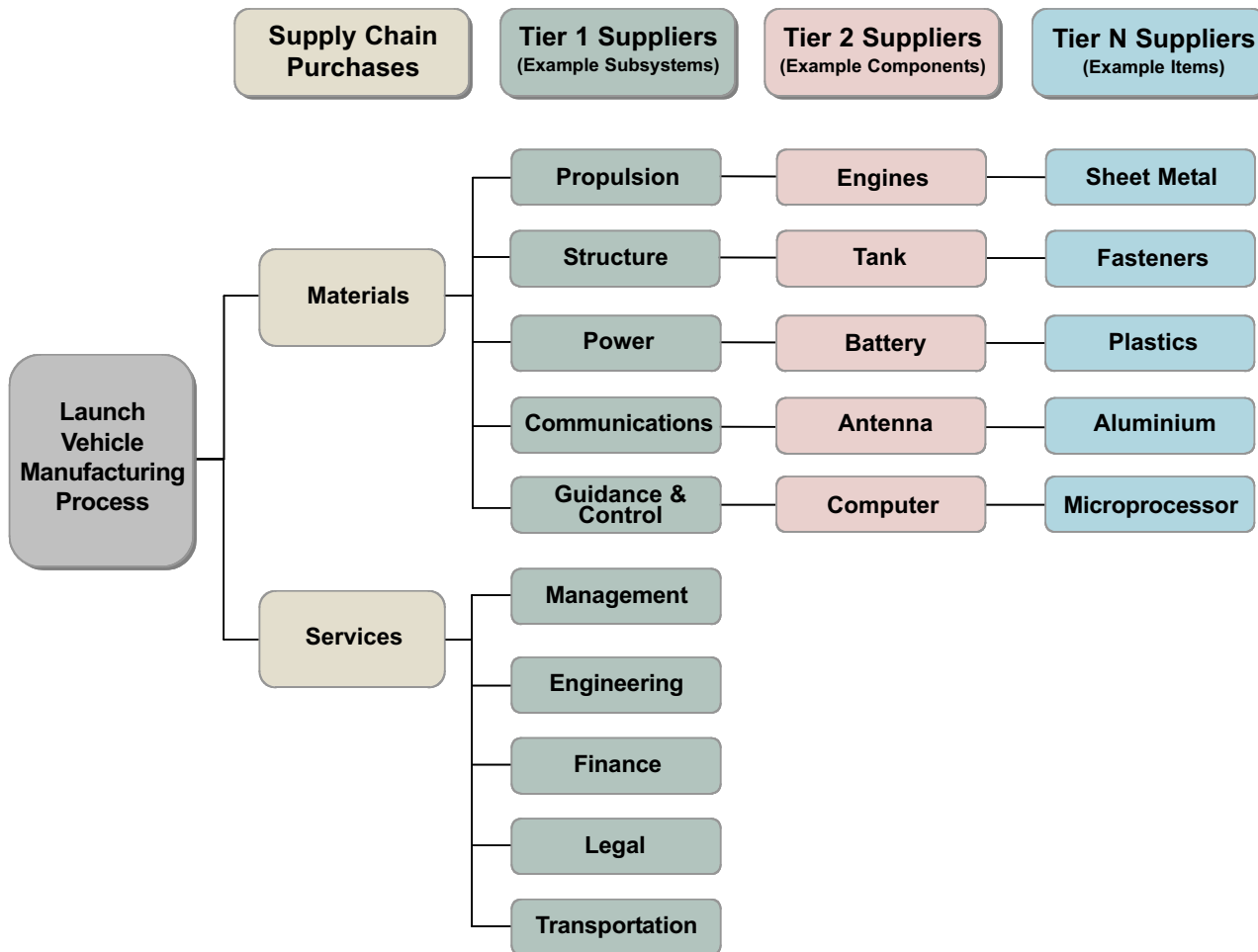




Figure 10: Partial Supply Chain of the Launch Vehicle Manufacturing Industry



A DAY IN THE LIFE OF A LAUNCH VEHICLE MANUFACTURING CEO



The economic impacts that launch vehicle manufacturing and enabled industries have on the U.S. economy arise due to direct spending on supply chain materials and services, indirect spending on secondary inputs to the manufacturing process, and induced spending which arises from the household expenditures of manufacturer and enabled industry employees. The following hypothetical “day in the life” of a CEO of a medium-sized launch vehicle manufacturing firm (LVM Inc.) illustrates the wide-ranging economic impacts of daily business activities and purchasing decisions undertaken by the CEO and her supply chain managers. In parentheses are examples of the industry sectors affected by each daily business task.

This morning’s tasks include revising LVM’s current materials and services demand forecast based upon new customer (commercial and government) contracts and orders received last week (business is very good this year!). Supply chain and logistics analysts log into the company’s enterprise resource planning system; they update the firm’s demand projections, bills of materials, list of qualified suppliers, orders to Tier 1 suppliers, and revisions to production capacity scheduling and resource constraints (information processing activity). New suppliers may need to be contacted and evaluated.



At lunchtime, LVM employees take a break to eat on-site at the lunch truck, or to go out to local restaurants (food and beverage services).

During the afternoon, new purchase orders are placed with suppliers for raw materials, components, production support items, and relevant transportation and logistics services (information processing). Human resources reviews staffing needs, and decides that in addition to expanding design, test and manufacturing engineering personnel, two new supplier relationship managers are required (enterprise management services). Revisions to LVM’s health and education benefit package are commenced, as HR feels that benefit improvements must be initiated in order to attract new staff (health care, education and insurance services).



LVM suppliers in turn initiate their own internal manufacturing, procurement and staffing processes in response to LVM orders, creating a “ripple effect” across manufacturing, services, transportation and warehousing, and other sectors providing inputs to the launch vehicle manufacturing industry.





The CEO spends an hour on the telephone with commercial and investment bankers, arranging a new line of credit, and informing Wall Street analysts of an upward revision in LVM's quarterly and annual financial performance targets (financial services). She reviews plans to build a new test and assembly facility in order to accommodate future growth in launch vehicle demand (construction and utilities).

Evening arrives, and the CEO and her employees depart for the day. Most go home to dinner with their families (food and beverage purchases), to watch television (entertainment services) and pay their bills (financial services). Some go to their local athletic club to work out (entertainment and recreation) before heading to a restaurant for dinner (food services). At the plant, the janitorial staff cleans up for the day in the offices and around the manufacturing and assembly floor.



On this particular day, LVM's launch vehicle manufacturing business activities have generated new orders and jobs for a variety of downstream components, materials and services firms, principally in associated manufacturing industries. By ordering more supplies, LVM also generated additional economic activity in service sectors

such as information processing and construction. Consumer spending by LVM employees and supplier companies' employees for food and beverages, health care, and financial services has also amplified the impact of LVM's business success. With many other firms, such as LVM's larger and smaller launch competitors, simultaneously performing similar business activities, the economic impact is significantly multiplied across the national network of commercial manufacturing and services suppliers, providing high-value jobs across the nation.

Study Comparisons

The period of 1999 to 2004 saw the total economic impact of commercial space transportation and enabled industries increase 60 percent, the earnings impact grow about 52 percent, and the number of jobs created rise about 11 percent. While there has been consistent growth for the group of commercial space transportation and enabled industries as a whole over this period, some industry segments have performed better than others. Figure 11 shows the total impact for economic activity, earnings, and jobs.

Figure 11: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999, 2002, and 2004¹⁰

Total Impact	1999	2002	2004
Economic Activity (\$000)	\$61,313,711	\$95,025,746	\$98,086,960
Earnings (\$000)	\$16,431,192	\$23,527,745	\$25,045,888
Jobs	497,350	576,450	551,350

EMPLOYMENT

The change in employment from 1999 to 2004 is shown in Figure 12. Similar to economic activity, the overall number of jobs increased over the five years as a result of business activity in the commercial space transportation and enabled industries. The change in number of jobs is commensurate with changes in economic activity of the corresponding industry segment. It should be noted that the employment data represents the total number of jobs in all affected industries, not just the industry itself.

The satellite and ground equipment manufacturing industries both experienced declines in employment from 1999 to 2004, although employment in launch vehicle manufacturing has recovered some of its 2002 losses. The changes in employment are commensurate with the industries' respective levels of economic activity. From 1999 to 2004, there was a reduction in launch and enabled industry manufacturing revenues. However, from 2002 to 2004, the economic impact of launch vehicle manufacturing more than doubled. These overall reductions mirror a larger trend in the United States towards a service economy, and are partially due to increased productivity, increased automation, technological innovations, and outsourcing of components. While some decline in manufacturing jobs is due to reduced production, the far larger share of employment changes occurs in the other affected industries.

¹⁰ Values shown are in current U.S. dollars, not adjusted for inflation.





Figure 12: Total Employment Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999, 2002, and 2004

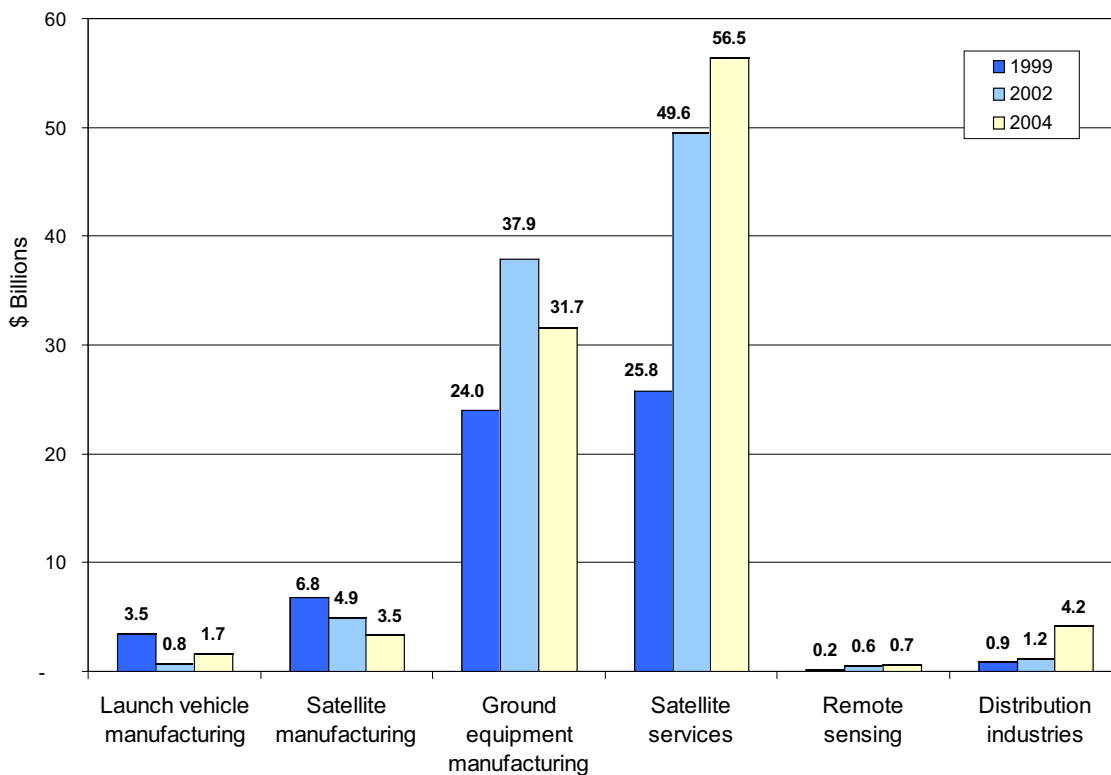
Industry	Employment (Jobs)		
	1999	2002	2004
Launch vehicle manufacturing	28,620	4,830	8,870
Satellite manufacturing	57,370	31,260	17,820
Ground equipment manufacturing	213,080	247,160	162,820
Satellite services	186,950	278,290	326,960
Remote sensing	2,820	5,110	5,700
Distribution industries	8,510	9,800	29,180
Total Impacts	497,350	576,450	551,350

ECONOMIC ACTIVITY

The launch vehicle industry in particular has bounced back from 2002 levels. The number of FAA-licensed orbital launches rose from 6 (plus five commercial Proton launches) in 2002 to 9 (plus 4 commercial Proton launches) in 2004. On the other hand, the satellite manufacturing industry experienced a relative decline in the number of U.S.-manufactured satellites. In 2002 there were 31 U.S.-manufactured satellites launched, whereas in 2004 that number fell to 25.

Satellite services cemented their position as the largest industry segment and have demonstrated a reliable record of growth. Within satellite services, the DTH component has been the driving force of growth. Remote sensing and distribution industries have also shown steady increases, while ground equipment manufacturing has leveled off as a mature industry. Figure 13 illustrates the industry-by-industry economic impact over the five-year period.

Figure 13: Total Economic Activity Impacts on the U.S. Economy of Launch Enabled Industries for Years 1999, 2002, and 2004¹¹



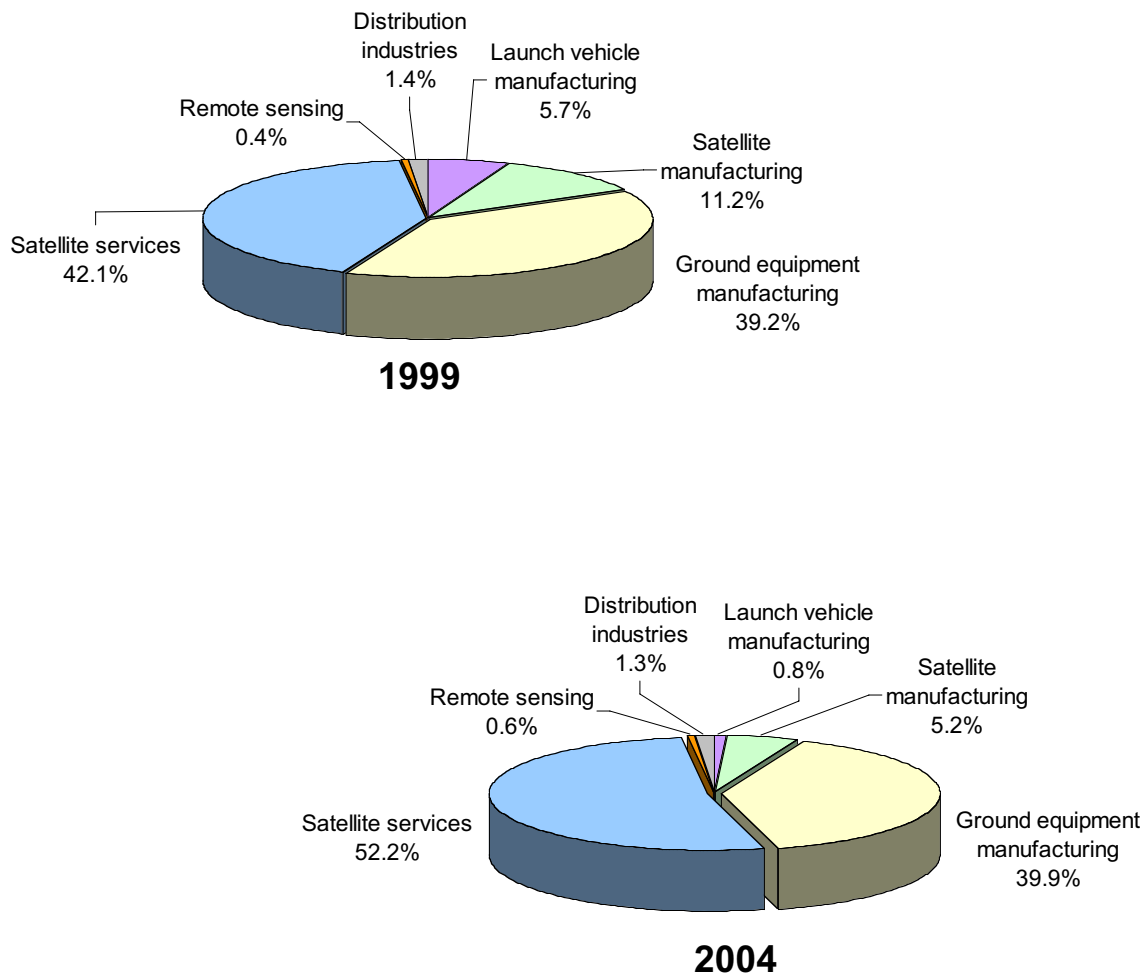
¹¹ Values shown are in current U.S. dollars, not adjusted for inflation. The increase in distribution industries impact can be attributed to a five-year national benchmark data update in the RIMS II model. If previous benchmark data is applied to current revenues, the 2004 distribution industries impact remains at the \$1.2 million of 2002.





Figure 14 compares the percentage of economic activity attributable to the different industry segments in 1999 and 2004. The U.S. satellite service industries grew the fastest in absolute terms and therefore experienced the most growth relative to the other industries. Satellite services' economic activity impacts increased ten percentage points, the share of ground equipment manufacturing impacts remained about the same, and satellite manufacturing economic activity impacts declined by six percentage points.

Figure 14: Distribution of Economic Activity Resulting from Commercial Space Transportation and Enabled Industries, 1999 and 2004



DIGITAL AUDIO RADIO SERVICES (DARS)

	Sirius	XM	Total
Number of subscribers (2004)	1,143,258	3,229,124	4,372,382
Number of subscribers (2003)	261,061	1,360,228	1,621,289
Number of subscribers (2002)	29,947	347,159	377,106
Revenues (2004)	\$66,854,000	\$244,443,000	\$311,297,000
Revenues (2003)	\$12,900,000	\$91,800,000	\$104,700,000
Revenues (2002)	\$805,000	\$20,181,000	\$20,986,000
Net loss (2004)	\$712,162,000	\$642,368,000	\$1,354,530,000
Total investment to date	\$3,350,000,000	\$3,200,000,000	\$6,550,000,000

Digital Audio Radio Services (DARS) is not included with other communications services in the overall analysis of the economic impact of commercial space transportation. The economic models used in the preparation of this analysis are dependent on the revenue recorded by the various industries enabled by commercial space transportation. This tends to underestimate the effect caused by the two companies providing DARS in the United States, XM Satellite Radio and Sirius Satellite Radio, because both companies still rely primarily on outside investment, rather than customer revenues, to fund their operations. The nature of those expenditures has shifted over the last few years from building up infrastructure (satellites, ground stations, terrestrial repeaters) to marketing and content expenses, including acquiring the rights to professional sports programming and hiring celebrities to host new shows. For example, in December 2003 Sirius paid \$220 million in cash and stock for the broadcasting rights to National Football League games for the next seven years, while in October 2004 XM signed an 11-year, \$650-million broadcast deal for Major League Baseball. These additional expenses have forced both companies to delay their transition to profitability.

Both DARS companies continue to make impressive progress in building up their businesses and the satellite radio field in general: the two DARS companies in the U.S. had over four million subscribers combined at the end of 2004, more than ten times the number just two years earlier (see Figure 16). XM Satellite Radio had over 3.2 million subscribers by the end of 2004, over twice as many as a year earlier; revenues also increased by a similar multiple. XM has offered commercial service since November 2001 using two satellites, XM-1 and 2 (also known as “Rock” and “Roll”) launched earlier in 2001. A third, XM-3, was launched in February 2005 and a fourth, XM-4, is scheduled for launch in 2007. These two satellites will replace XM-1 and 2, which are experiencing gradual losses in power because of a solar panel system defect. In June 2005 XM ordered a fifth satellite from Space Systems/Loral that will be used as a ground spare. Through the end of 2004 the company had raised \$3.2 billion and expects to reach cash flow breakeven in 2006. The company had 577 employees as of the end of 2004.



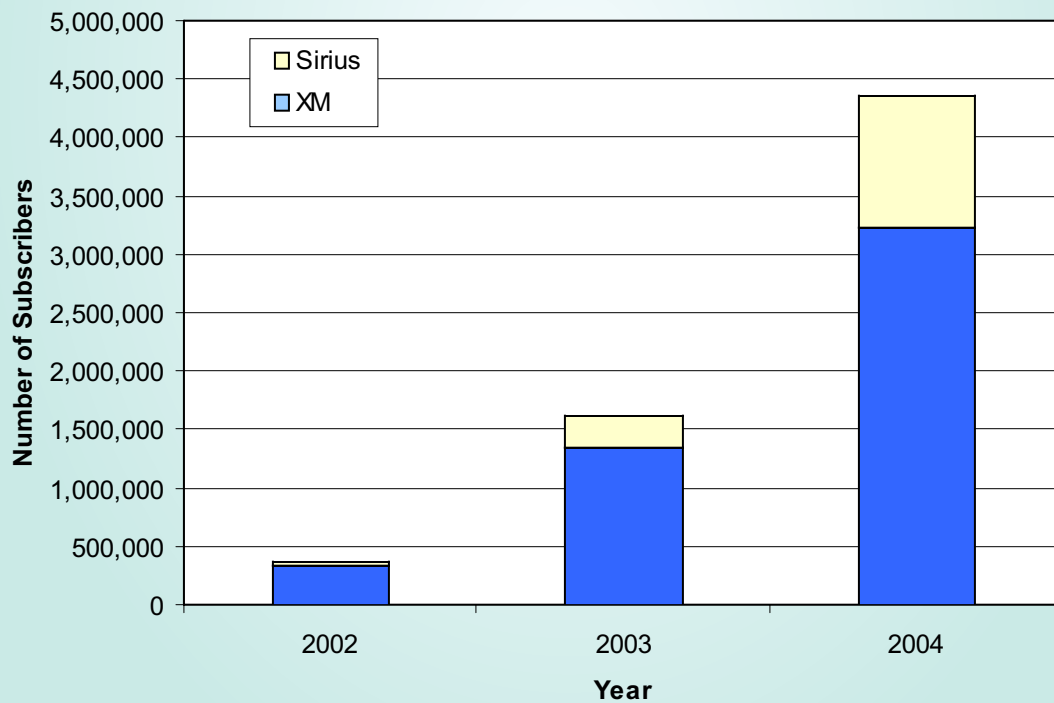


DIGITAL AUDIO RADIO SERVICES (DARS) CONT'D

Sirius Satellite Radio launched its satellites earlier than XM—three Protons placed the company’s three satellites into highly elliptical orbits in late 2000—but did not begin commercial service until July 2002 because of technical issues. As a result, the service has fewer subscribers than XM. Sirius, though, is closing the gap: its subscriber base was one-fifth the size of XM’s at the end of 2003, but was one-third as big as XM a year later. The company has raised a total of \$3.35 billion since its inception, and believes it has enough money to take it through the cash-flow breakeven point in 2007. The company had 514 employees as of March 2005.

Should these companies continue to grow and achieve cash flow breakeven in the near future, as planned, then these companies, and the DARS industry in general, will be mature enough to be included in future economic analyses.

Figure 16: Growth of DARS Subscribers



Industry Comparisons

Commercial space transportation and its enabled industries contribute significantly to the U.S. economy. This section compares other national economic impact studies from 2000 to 2004 with the contributions of commercial space transportation in 2004. The majority of studies selected for comparison utilize the RIMS II input/output model, while the beer and timeshare studies use the IMPLAN model. IMPLAN is a regional economic modeling system, similar to the RIMS II model, which is maintained and sold by a private company.

Two of the studies included here are for the transportation industries of civil aviation and cruise ships. The FAA completed a study in April 2003 titled, *“The Economic Impact of Civil Aviation on the U.S. Economy.”* In August 2004, Business Research and Economic Advisors published a study, *“The Contribution of the North American Cruise Industry to the U.S. Economy in 2003,”* for the International Council of Cruise Lines. Both studies used the RIMS II input/output model to quantify economic impacts. Figure 17 shows that the economic impact of the civil aviation industry is over 10 times that of commercial space transportation and enabled industries, while the impact of the cruise line industry is around four times smaller.

Figure 17 also illustrates how the economic impact of commercial space transportation and enabled industries compares with non-transportation industries. Commercial space transportation and enabled industries has a greater impact on the U.S. economy than the timeshare and cruise line industries combined.

Figure 17: Comparison of Economic Impacts of Commercial Space Transportation and Enabled Industries and Other Industry Sectors

Industry (year of impacts)	Economic Activity (\$billion)	Earnings (\$billion)	Jobs
Civil Aviation (2000) ¹²	\$1,008.2	\$310.1	10,000,000
Biopharmaceutical (2003) ¹³	\$172.0	\$29.5	2,700,000
Beer (2004) ¹⁴	\$162.0	\$54.0	1,783,000
Dairy (2002) ¹⁵	\$138.0	\$28.0	922,000
Commercial Space Transportation and Enabled Industries (2004)	\$98.1	\$25.0	551,000
Commercial Space Transportation and Enabled Industries (2002)	\$95.0	\$23.5	576,000
Timeshare (2002) ¹⁶	\$44.4	\$15.9	476,000
Cruise Lines (2003) ¹⁷	\$25.4	\$11.6	295,000

¹² *“The Economic Impact of Civil Aviation on the U.S. Economy, Update 2000,”* published by Wilbur Smith Associates in April 2003 for the Federal Aviation Administration.

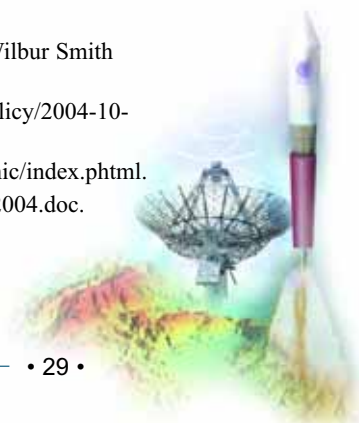
¹³ *“Economic Impact of the Biopharmaceutical Industry,”* <http://www.phrma.org/publications/policy/2004-10-12.1090.pdf>.

¹⁴ *“The Economic Contribution of the Beer Industry,”* <http://www.beerservesamerica.org/economic/index.phtml>.

¹⁵ *“The Economic Impact of the Dairy Industry,”* http://www.nmpf.org/files/US_Outlook_May_2004.doc.

¹⁶ *“Economic Impact of the Timeshare Industry on the U.S. Economy,”* http://www.arda.org/AM/Template.cfm?Section=April_28_2004.

¹⁷ *“The Contribution of the North American Cruise Industry to the U.S. Economy in 2003,”* http://www.iccl.org/resources/2003_economic_study.pdf.





Emerging Markets for Future Consideration

Commercial space transportation has technologically enabled the existence and continued growth of industries highlighted in this report. Now, these same industries, in aggregate, create a multi-billion-dollar impact on the U.S. economy annually. In the coming years, commercial space transportation will enable the emergence of new industries that will impact the U.S. economy. Both existing and emerging industries will help sustain a robust U.S. launch market. Examples of some of these emerging industries include:

PUBLIC SPACE TRAVEL

Public space travel, or space tourism, has the potential to become a major growth industry. Already two people—Dennis Tito in 2001 and Mark Shuttleworth in 2002—have paid an estimated \$20 million each for weeklong trips to the International Space Station, with a third, Gregory Olsen, flying to the station in October 2005. Las Vegas-based Bigelow Aerospace is developing inflatable orbital habitats that could be used for tourist flights. The company is also sponsoring the \$50-million America's Space Prize for the development of an orbital vehicle that can ferry passengers to and from those habitats.

Prospects for suborbital space tourism got a major boost in October 2004 when SpaceShipOne, developed by Scaled Composites and funded by Microsoft co-founder Paul Allen, won the \$10-million Ansari X Prize by performing two piloted suborbital spaceflights within two weeks. Virgin Galactic, a subsidiary of Sir Richard Branson's Virgin Group, has licensed the SpaceShipOne technology and, in July 2005, announced the formation of a joint venture with Scaled Composites, called The Spaceship Company, to build a new vehicle, SpaceShipTwo, that will enter commercial service around 2008. Virgin Galactic has announced plans to sell tickets on SpaceShipTwo initially for \$200,000, decreasing the price to as low as \$50,000 within five years. Several other companies in the U.S. and elsewhere, including former Ansari X Prize competitors are also planning to offer suborbital space tourism services by the end of the decade. These developments have been aided by the passage in late 2004 of the Commercial Space Launch Amendments Act, which establishes key elements of the regulatory framework needed for the suborbital space tourism industry.

Recent market studies have shown that public space travel has the potential to become a billion-dollar industry within 20 years. Moreover, public space travel may provide the initial market for suborbital vehicles that can also serve other markets, including microgravity research, remote sensing, and fast package delivery. *The Economic Impact of Commercial Space Transportation on the U.S. Economy* published in March 2004 included an outlook through 2010 of the potential impacts of public space travel.

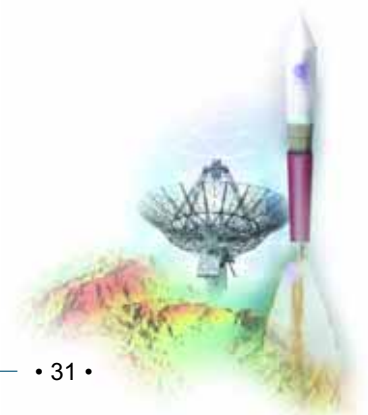
REAL-TIME REMOTE SENSING APPLICATIONS

Remote sensing from space has provided the world with powerful data and tools for tracking environmental change, disease control, crop management, and areas of military interest. As

data management technology and remote sensing end-user technologies evolve to provide next-generation services such as real-time applications, the demand for satellites to provide services will likely increase. Commercial space transportation will play an integral role in ensuring the continued data flow of today's remote sensing satellite systems as well as the data from next-generation systems.

BROADBAND DATA SERVICES

Demand for broadband Internet access continues to grow, both in the U.S. and worldwide. However, for some people it is difficult to obtain service from terrestrial broadband providers, particularly in rural areas with limited infrastructure. A new generation of broadband communications satellites planned for launch over the next several years promises to solve this “last mile” problem and provide broadband Internet access to all potential users, in much the same way as DTH provided an alternative to cable television a decade ago. If these ventures are successful it may prompt the development of additional systems, further supporting the commercial space transportation industry.





Appendices





APPENDIX A: METHODOLOGY

Methodology Overview

This study utilizes the Regional Input-Output Modeling System (RIMS II) developed by the U.S. Department of Commerce's Bureau of Economic Analysis to quantify the economic value of financial transactions that are associated directly and indirectly with commercial space transportation and enabled industries. The flow of funds is traced through the economy in order to identify which industry types benefit and by how much. The study follows FAA-recommended procedures for economic impact analysis, including the use of RIMS II. The revenue data used to calculate the impacts shown in this report were derived from the results of the Satellite Industry Association's (SIA) *2004 Satellite Industry Annual Indicators Study*.¹⁸

ECONOMIC IMPACTS VS. ECONOMIC BENEFITS

Commercial space transportation and enabled industries are responsible for both economic impacts on and economic benefits to the national economies.

Economic impacts are the quantifiable interactions between consumers and producers that result from a change in final demand for a product or a service. These impacts track the financial transactions that occur throughout the production of a good or service, and they are measured here in terms of increased economic activity, earnings, and jobs.

Economic benefits are wider in scope and generally include the intangible, positive effects that result from the availability of certain goods and services in the U.S. economy. Typically described as advantageous changes in quality of life or quality of business, benefits comprise technological, financial, societal, and environmental improvements. Examples of economic benefits include decreased transaction time, cost savings, cost avoidance, improved productivity, increased efficiency, development of new technologies, technology diffusion, and attraction of new businesses to a region.

This study examines the quantifiable economic impacts on the U.S. economy of the commercial space transportation industry and the industries it enables. Only the economic activities that occur during production of a good or the rendering of a service are taken into account.

Measuring Economic Impacts

The base size or annual growth of an industry may be measured in several ways, including revenues, profits, investments in research and development, number of employees, or total number of businesses. The analysis featured in this report, however, extends beyond these

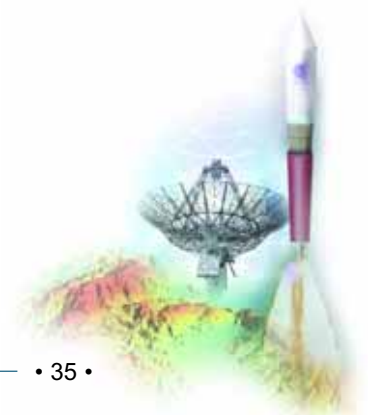
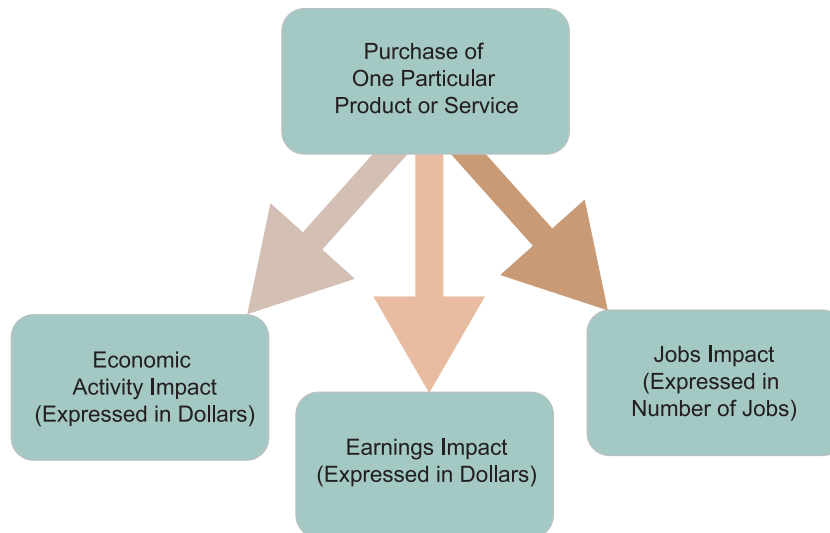
¹⁸ The data collected from the SIA survey have been manipulated to accommodate industry definitions determined to be appropriate for this report. Revenue data may differ from that reported by SIA.

basic measures by using multipliers to quantify the economic impact of certain industries on the nation as a whole. Multipliers are mathematical factors used to calculate the value of an initial amount of spending on a good or service plus the value of additional spending linked to the purchase of inputs required to produce that final good or service. Economic impact analyses take into account the multiplier effect that one industry (or group of industries) has on all other industries throughout the economy.

Types of Impacts Measured

Economic impacts are measured here in three ways: economic activity, earnings, and jobs. Economic activity, earnings, and jobs impacts measure the effects of the same change in final demand (for example, the purchase of a launch vehicle), in different ways: some in dollars and others in numbers of jobs (see Figure A1). For example, the purchase of one launch vehicle will stimulate economic activity, increase earnings, and create jobs in other industry groups. However, because all these impacts are based on the same change in final demand, they cannot be added together.

Figure A1: Different Measures of Impact for a Single Change in Final Demand



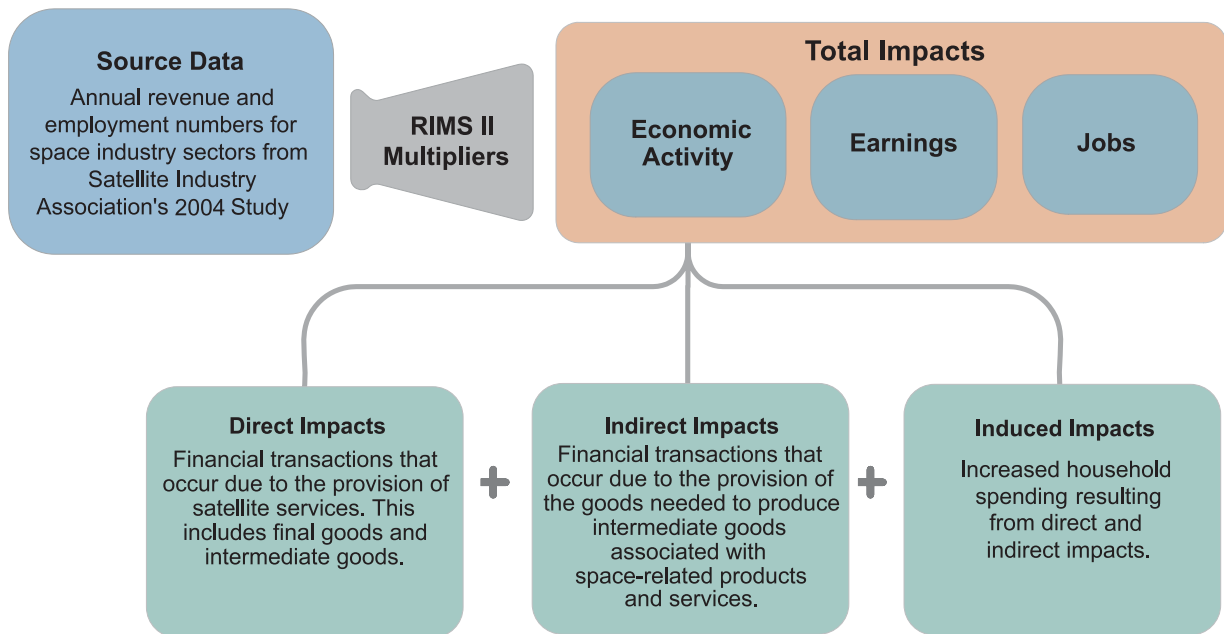


RIMS II

For this study, economic impacts were derived using the Regional Input-Output Modeling System (RIMS II), an economic input-output model developed by the Department of Commerce's Bureau of Economic Analysis. RIMS II maps the flow of goods and services within the U.S. economy and illustrates the interconnection of producers and consumers. RIMS II is comprised of several sets of multipliers that can be used to measure individual industries' contributions to the economy. The multipliers are organized by industry groups. These industry groups are categorized by input-output (I-O) codes, which are based on North American Industry Classification System (NAICS) codes. Appendix B describes the translation of the industries studied into applicable RIMS II categories.

The source data from the SIA study were used with RIMS II to derive the total economic impacts of the selected industries. The total impacts are expressed in terms of economic activity, employment, and earnings. Further calculations were used to derive the direct, indirect, and induced effects of economic activity. Figure A2 illustrates this methodology.

Figure A2: Simplified Methodology for Using RIMS II



APPENDIX B: SELECTION OF INDUSTRIES FOR ANALYSIS

RIMS II input-output (I-O) codes are based on North American Industry Classification System (NAICS) codes. The NAICS codes selected were those that were most related to commercial space transportation and enabled industries. From the selected NAICS codes, I-O codes were assigned to accurately characterize the impact of the commercial space transportation industry. SIA source data were then sorted by I-O code. Figure B1 depicts the relationships between the industries selected for study and their appropriate NAICS codes, I-O code, and SIA industry segment.

Figure B1: Selected NAICS and Input-Output Codes for Industry Segments

NAICS Code	Description	I-O Code	Description	SIA Industry Segment
334220	<i>Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.</i> This U.S. industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.	334220	MANUFACTURING: Audio, video, and communications equipment manufacturing: <i>Broadcast and wireless communications equipment</i>	Satellite manufacturing
334220	<i>Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.</i> This U.S. industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.	334220	MANUFACTURING: Audio, video, and communications equipment manufacturing: <i>Broadcast and wireless communications equipment</i>	Ground equipment manufacturing
336414	<i>Guided Missile and Space Vehicle Manufacturing.</i> This U.S. industry comprises establishments primarily engaged in (1) manufacturing complete guided missiles and space vehicles and/or (2) developing and making prototypes of guided missile or space vehicles.	336414	MANUFACTURING: Aerospace product and parts manufacturing: <i>Guided missile and space vehicle manufacturing</i>	Launch vehicle manufacturing and services
513220	<i>Cable and Other Program Distribution.</i> This industry comprises establishments primarily engaged as third-party distribution systems for broadcast programming. The establishments of this industry deliver visual, aural, or textual programming received from cable networks, local television stations, or radio networks to consumers via cable or direct-to-home satellite systems on a subscription or fee basis. These establishments do not generally originate programming material.	513200	INFORMATION: Cable networks and program distribution: <i>Cable networks and program distribution</i>	Direct-to-Home (DTH) TV Services





Figure B1: Selected NAICS and Input-Output Codes for Industry Segments (Cont'd)

NAICS Code	Description	I-O Code	Description	SIA Industry Segment
513340	<i>Satellite Telecommunications.</i> This industry comprises establishments primarily engaged in providing point-to-point telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.	513300	INFORMATION: Telecommunications: <i>Telecommunications</i>	VSAT services
513340	<i>Satellite Telecommunications.</i> This industry comprises establishments primarily engaged in providing point-to-point telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.	513300	INFORMATION: Telecommunications: <i>Telecommunications</i>	Data services
513340	<i>Satellite Telecommunications.</i> This industry comprises establishments primarily engaged in providing point-to-point telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.	513300	INFORMATION: Telecommunications: <i>Telecommunications</i>	Transponder leasing
513340	<i>Satellite Telecommunications.</i> This industry comprises establishments primarily engaged in providing point-to-point telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.	513300	INFORMATION: Telecommunications: <i>Telecommunications</i>	Mobile satellite telephony
541370	<i>Surveying and Mapping (Except Geophysical) Services.</i> This industry comprises establishments primarily engaged in performing surveying and mapping services of the surface of the earth, including the sea floor. These services may include surveying and mapping of areas above or below the surface of the earth, such as the creation of view easements or segregating rights in parcels of land by creating underground utility easements.	541300	PROFESSIONAL AND TECHNICAL SERVICES: Architectural and engineering services: <i>Architectural and engineering services</i>	Remote sensing