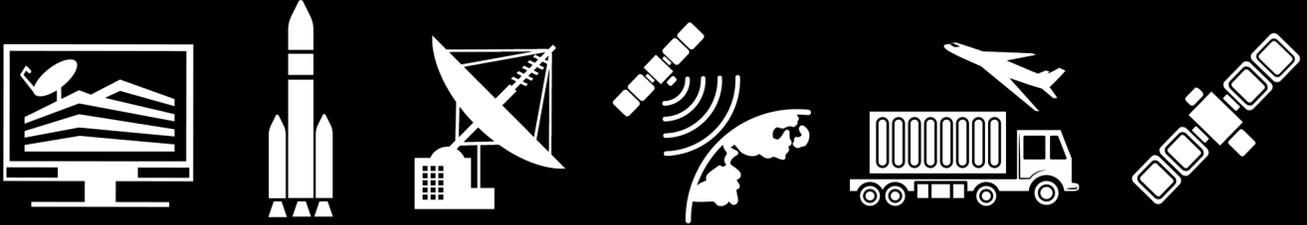




**Federal Aviation
Administration**



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

April 2008



U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Associate Administrator for
Commercial Space Transportation

800 Independence Ave., SW.
Washington, DC 20591

April 2008

Dear Colleague:

The FAA Office of Commercial Space Transportation is pleased to issue this study, entitled “The Economic Impact of Commercial Space Transportation on the U.S. Economy.”

The study, the fourth in a series of comparable surveys, evaluates data from 2006 to calculate the overall economic impact of the U.S. commercial launch industry and the industries enabled by it.

The findings are very encouraging. Economic activity, earnings, and jobs are all on the rise, showing significant increases since 2004.

For the first time, the analysis includes Digital Audio Radio Service (DARS). This sector has now reached a level of revenues that warrants representation under satellite services. Progress like this speaks to the ongoing growth of the commercial space transportation industry.

Emerging “NewSpace” companies are currently in the process of creating and advancing technologies that will reshape the economic profile of the commercial space community. Though not included in this survey, we expect that revenues from “NewSpace” companies will soon climb to a level substantial enough to register in future economic impact studies.

What follows is a report of steady and genuine progress in an exciting field vital to the nation’s future. We believe it is the preface to many technical and economic advances yet to come.

Sincerely,

A handwritten signature in black ink, appearing to read "George Nield". The signature is fluid and cursive, with a large initial "G" and "N".

Dr. George C. Nield
Acting Associate Administrator for
Commercial Space Transportation

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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 quantifies how commercial space transportation is responsible for supporting space- and non-space-related industries.

The associated industries that commercial space transportation enables include launch vehicle manufacturing, satellite manufacturing, ground equipment manufacturing, satellite services, remote sensing, and distribution industries. Together these industries contribute to production activity, create earnings, and support jobs throughout the United States. The U.S. Department of Commerce’s RIMS II economic model is combined with Satellite Industry Association revenue inputs to calculate how the industries influence the three impact metrics in all major U.S. industry groups.

In 2006, commercial space transportation and enabled industries generated a total of \$139.3 billion in economic activity, \$35.7 billion in earnings, and supported over 729,000 jobs throughout the U.S. economy.¹ These results show that the economic impact of commercial space transportation on the U.S. economy has grown. Figure E1 compares these results with three similar studies published in 2001, 2004, and 2006. These studies measured the economic impact of the same industries in 1999, 2002, and 2004, respectively. All three of the impact measures increased in 2006 relative to 2004. The increase is primarily caused by growth in enabled industry activity, particularly satellite services.

Total Impact	1999	2002	2004	2006
Economic Activity (\$000)	\$61,313,711	\$95,025,746	\$98,086,960	\$139,262,027
Earnings (\$000)	\$16,431,192	\$23,527,745	\$25,045,888	\$35,659,935
Jobs	497,350	576,450	551,350	729,240

Figure E1: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999, 2002, 2004, and 2006.

The industries exhibit an overall economic impact growth trend from 1999 to 2006, except for a slightly decreased employment impact from 2002 to 2004. Consistent growth in satellite services revenue, particularly in direct-to-home television (DTH TV), is the major cause for this increasing trend. The growth has not been uniform across all industry sectors during this period, as summarized in the comparison of economic activity impacts in Figure E2. Launch vehicle manufacturing was the only industry to experience a decrease from 2004 to 2006, while satellite and ground equipment manufacturing both rebounded from previous drops. The satellite services sector showed extreme growth because of continued increasing demand for DTH TV services. In addition, satellite digital audio radio service (DARS) was

¹ Values throughout the report are in current U.S. dollars, not adjusted for inflation.

included in the study's model—under the satellite services sector—for the first time. That segment is now creating a significant impact on the economy. Remote sensing and distribution industries continued to show modest growth in 2006, as in previous years. These positive trends are encouraging for the commercial space transportation industry.

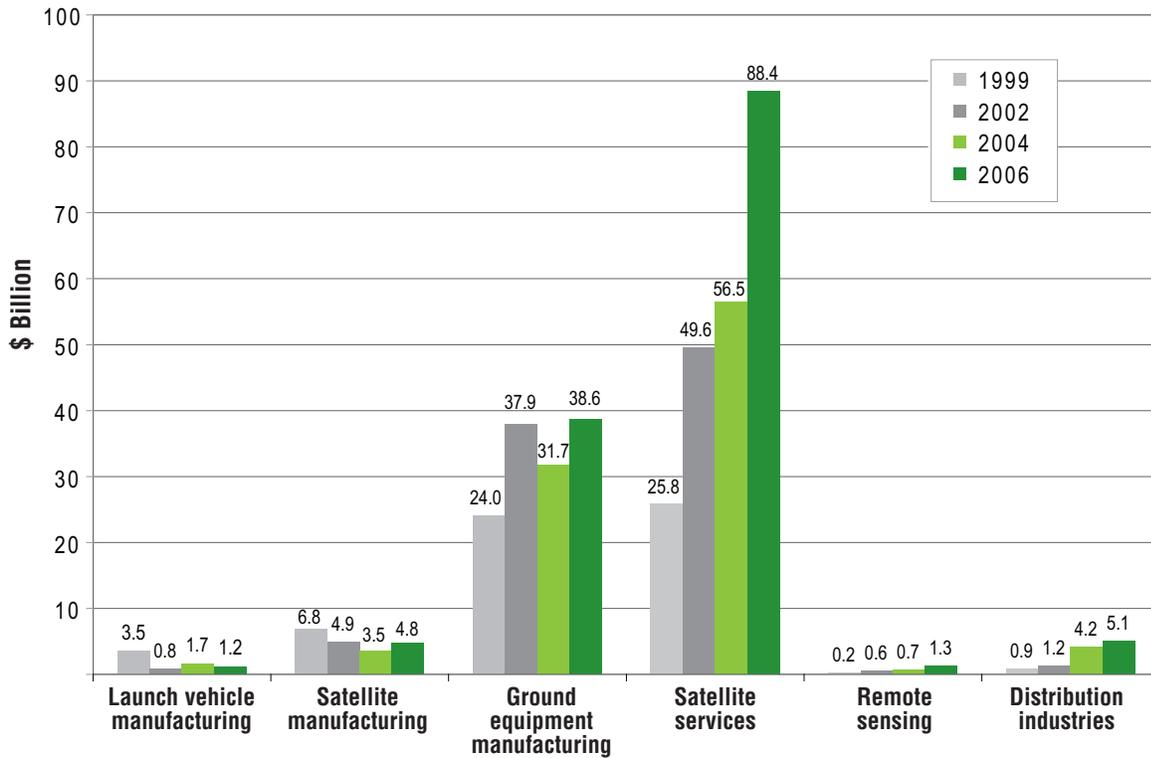


Figure E2: Total Economic Activity Impacts on the U.S. Economy of Commercial Space Transportation and Enabled Industries, 1999, 2002, 2004, and 2006.

1. Introduction

Commercial space launch activity plays an important economic role within the United States. *The Economic Impact of Commercial Space Transportation on the U.S. Economy* is FAA/AST's study of commercial space transportation's affects on the overall national economy. The report is a quantitative analysis of the commercial space transportation's direct and indirect effects on the U.S. economy. In addition to the space-related industries, commercial space transportation is responsible for supporting non-space-related industries, thereby contributing to the total economic output and generating earnings and jobs throughout the United States. The figures in this report do not simply present the revenues and employment statistics for the commercial launch industry. Rather, the report quantifies the economic impact that occurs in all industries throughout the U.S. national economy.

The U.S. commercial launch industry began with the launch of 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 and continued to launch commercial payloads in the early space age. The first U.S. Government-licensed commercial orbital launch took place in August 1989 when a Delta 4925 carried the Sirius 1 communications satellite into orbit. There have been more than 180 orbital and suborbital U.S. Government-licensed launches since that time.

Advances in the commercial space transportation industry have led to growth within other industries. In addition to contributing sophisticated technologies, the commercial launch industry has sparked economic growth by fostering new commercial markets. It has enabled satellite manufacturing, satellite communications services, remote sensing, and satellite ground equipment manufacturing. By producing reliable, more capable launch vehicles, the commercial space transportation industry enables the growth of markets for satellite services and satellite and ground equipment.

Communication satellite use has evolved from simple infrastructure applications such as telephone trunking and television transmission to more complex, value-added services including direct-to-home television (DTH TV), data services, very small aperture terminal (VSAT) services, and most recently, digital audio radio service (DARS). The commercial satellite remote sensing industry has also expanded in recent years. The growth of these satellite applications has, in turn, sustained markets for satellite and ground equipment manufacturing.

The commercial launch industry promotes developing 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. These enabled industries are examined along with the commercial launch industry, as the study's primary industries, to assess the full impact of commercial space transportation on the U.S. national economy.

Enabled Industries

The commercial space transportation industry provides access to space to a range of other industries. Without commercial launch opportunities, these industries would not exist. Therefore, these industries are considered enabled by commercial space transportation. The enabled industries include commercial space industry sectors such as satellite manufacturing of commercial satellites, but not that of government satellites. These industries are a significant part of this economic impact study.

2. Study Objectives

This report on economic impacts aims to show how commercial space transportation and its enabled industries affect the overall economy.² This year's study describes the impact on the U.S. national economy in 2006. It highlights other industry groups that profit from commercial space transportation activity and the extent to which these industries are affected. The study quantifies how much economic activity is generated, how much income is earned, and how many jobs are supported in other industry groups during the year as a result of commercial space transportation and enabled industries. FAA/AST previously published studies of the U.S. commercial space transportation's effect on the nation's economy in 2001, 2004, and 2006. These economic impacts measured activity for the years 1999, 2002, and 2004, respectively. This current report compares the economic impacts in 2006 with the results from these three previous studies. It also compares the economic impacts of commercial space transportation and enabled industries to the impacts of other selected industries on the U.S. economy.

2.1 APPROACH

The Economic Impact of Commercial Space Transportation on the U.S. Economy uses impact modeling procedures for quantitative analysis. The process includes 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 (BEA). The study uses FAA-accepted methods to calculate the value of financial transactions associated directly or indirectly with commercial space transportation and enabled industries. Within the model, financial transactions are traced through the economy in order to identify by how much industry groups benefit from commercial space transportation activity.

RIMS II calculates the national economic impact of commercial space transportation and enabled industries within the United States. Economic impacts are measured in terms of economic activity (revenues), employee earnings, and jobs supported within the commercial launch and enabled industries and within other industries through direct, indirect, and induced economic activity.

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

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, Chapter 701.

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

2.2 INDUSTRIES INCLUDED IN THE ANALYSIS

Each icon appearing in the cover artwork of this report is representative of each of the six industries included in this analysis. Figure 1 describes these industries from which the economic impacts are calculated. The list comprises the commercial launch industry as well as the enabled industries.

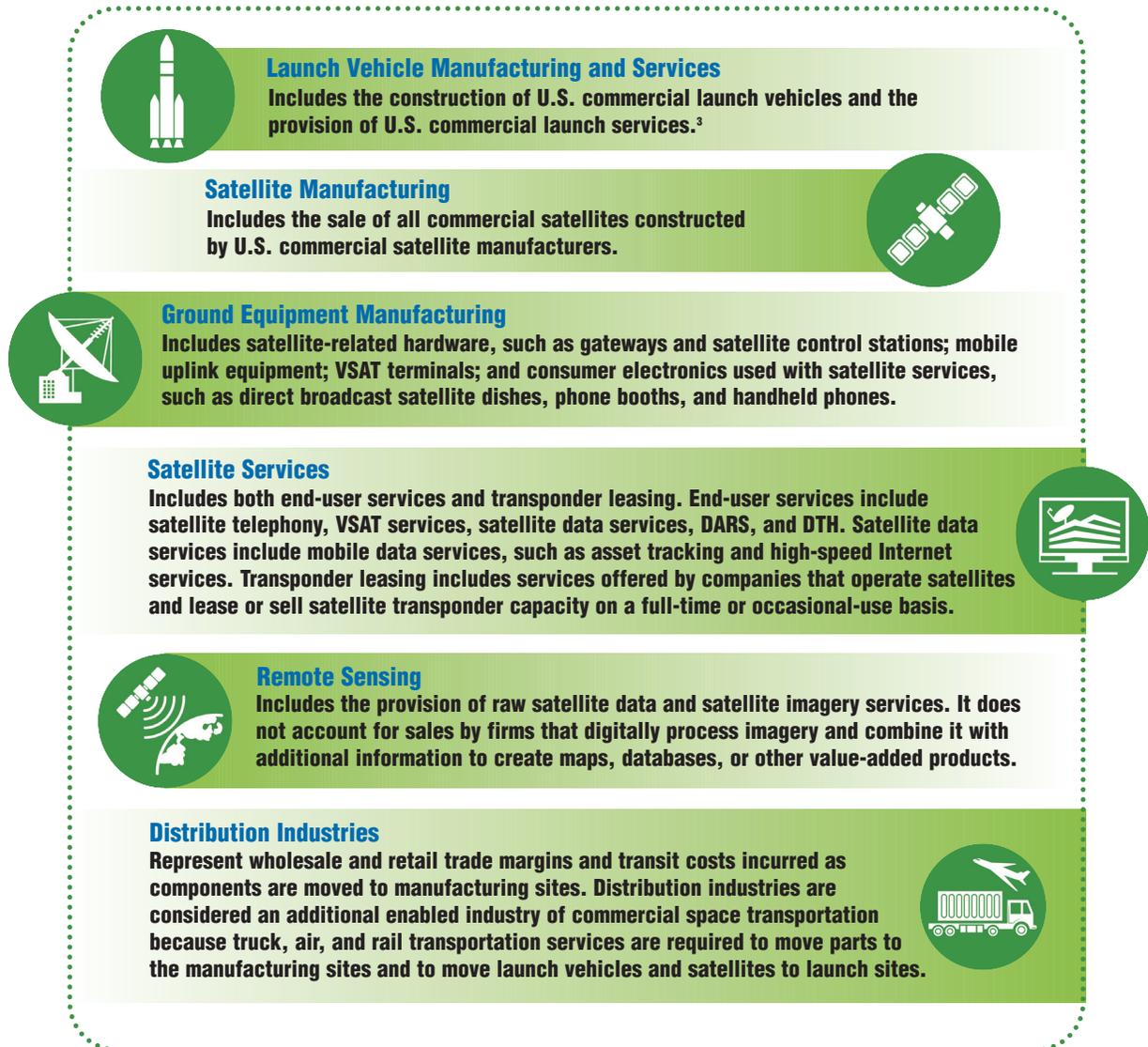


Figure 1: Industries Included in Analysis

³ Launches by Sea Launch are included in the commercial launch industry revenue input because Sea Launch is considered a U.S. company whose launches are both commercial and licensed by the FAA.

2.3 RIMS II MODEL

RIMS II is a widely used and accepted economic input-output model developed by BEA 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 study methodology, including the way that RIMS II is used to generate the data for this study. Appendix B describes how the particular industries studied are placed into industry categories, based on input-output codes, for use with RIMS II.

RIMS II is based on the North American Industry Classification System, which incorporates certain industry classification categories and uses updated multiplier data for calculating economic impact based on industry revenues.⁴ The RIMS II model goes through periods of improvement by BEA. These improvements have important effects on how economic impacts are calculated within the model. Since the previous study published in 2006, there have not been any major changes to RIMS II that would alter calculated impacts. There were significant changes to RIMS II between 2002 and 2004, though. These changes are described in Appendix A.

2.4 SOURCE DATA

Revenue data inputs for commercial space transportation and the enabled industries are necessary for RIMS II economic impact analysis. The input revenue information used to derive the output impacts shown in this report is based on the results of the Satellite Industry Association's (SIA) 2006 Satellite Industry Annual Indicators Study. SIA has conducted an annual survey of hundreds of companies within the global space industry for the last ten years to determine total revenue amounts for the global space industry.⁵ The revenue is segmented into the commercial launch, satellite manufacturing, satellite services, remote sensing, and ground equipment industries, broken into U.S. and world revenue segments.

Only *U.S.* revenues and economic impacts on the industries that *commercial* space transportation enables are included in this study. This data input constraint ensures that calculated impacts are limited to commercial activity within the U.S. national economy. The data does not include impacts of activities enabled by Space Shuttle launches or other government expendable vehicle launches, such as revenues from the launch of the military Global Positioning System (GPS) satellites and, therefore, sales of handheld GPS navigation devices.

⁴ A detailed description of the NAICS code system can be found at <http://www.naics.com/info.htm>.

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

3. Measuring Economic Activity Impacts

Transactions within the commercial space transportation and enabled industries impact all other industry sectors. In this study, economic impacts measure economic activity (revenues), earnings, and employment supported throughout all industries in the national economy. The impact results are a factor of the change in final demand for products or services offered by commercial space transportation and the enabled industries. Following are the definitions for each type of impact:⁶

- Economic activity is the value of goods and services produced in an economy, measured in revenue generated. 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 these 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 these industries.
- Employment, or jobs, refers to the total number of workers employed to support the production of 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 these industries.

Commercial space transportation and enabled industries were responsible for \$139.3 billion in economic activity in 2006 (see Figure 2). As a result of this

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

Industry Group	Economic Activity (\$000)	Earnings (\$000)	Employment (Jobs)
Launch vehicle manufacturing	\$1,166,723	\$308,087	5,690
Satellite manufacturing	\$4,750,900	\$1,162,252	22,320
Ground equipment manufacturing	\$38,648,397	\$9,454,876	181,550
Direct-to-home (DTH) TV services	\$70,868,983	\$18,284,817	383,030
VSAT services	\$3,895,950	\$1,000,950	20,740
Satellite data services	\$561,017	\$144,137	2,990
Transponder leasing	\$7,859,430	\$2,019,250	41,840
Mobile satellite telephony	\$376,609	\$96,759	2,010
Remote sensing	\$1,264,423	\$439,571	10,060
Satellite Digital Audio Radio Service	\$4,815,743	\$1,242,504	26,030
Distribution industries	\$5,053,854	\$1,506,734	32,980
Total Impacts	\$139,262,027	\$35,659,935	729,240

Figure 2: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 2006.

economic activity, employees in all industry groups earned a total of \$35.7 billion in salaries and wages and over 729,000 total jobs were supported throughout the economy.

Economic Impacts

Three economic impact metrics are studied in this report: Economic activity, earnings, and the number of jobs supported throughout the U.S. economy during the year.

The economic activity includes \$88.4 billion generated by satellite services and \$38.6 billion from the manufacture of ground equipment, the top two revenue contributors. The satellite services impact grew significantly from 2004, based on a continued strong DTH TV sector that created \$70.9 billion in economic activity. Launch vehicle manufacturing and services generated \$1.2 billion and the satellite manufacturing sector generated \$4.8 billion in economic activity in 2006. Distribution industry activity related to the primary industries studied was responsible for \$5.1 billion, while the enabled remote sensing sector created \$1.3 billion of activity within the U.S. economy.

Each measure of economic activity impact described above contains three components:⁷

- Direct impacts are the expenditures on inputs and labor involved in providing any final good or service relating to the primary industries analyzed in this report.
- Indirect impacts involve the purchases (e.g., metals, composite materials, processors) made by and labor supplied by the industries providing 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 resulting from the direct and indirect impacts (e.g., a spacecraft solar array design engineer's spending on food, clothes dry-cleaning, or any other household good and service).

As shown in Figure 3, the output of the commercial space transportation and enabled industries yields direct impacts, which in turn result in indirect and induced impacts. Demand for commercial space transportation results in payments to workers, including personnel working for launch service providers, steelworkers providing materials for launch vehicles and satellites, and food service employees feeding all of these workers. Workers then re-spend these payments in local economies.

Purchases of inputs from supplier industries are captured in the indirect impact and employees' household spending is captured in the induced impact. These indirect and induced impacts tend to be larger than the direct impact. This is the case because the value of the final goods and services sold (the direct revenue) is often lower than the value of the components that are used to create these goods and services. For the service industries, the largest investment is often in the salaries of the workers needed to provide the service.

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.

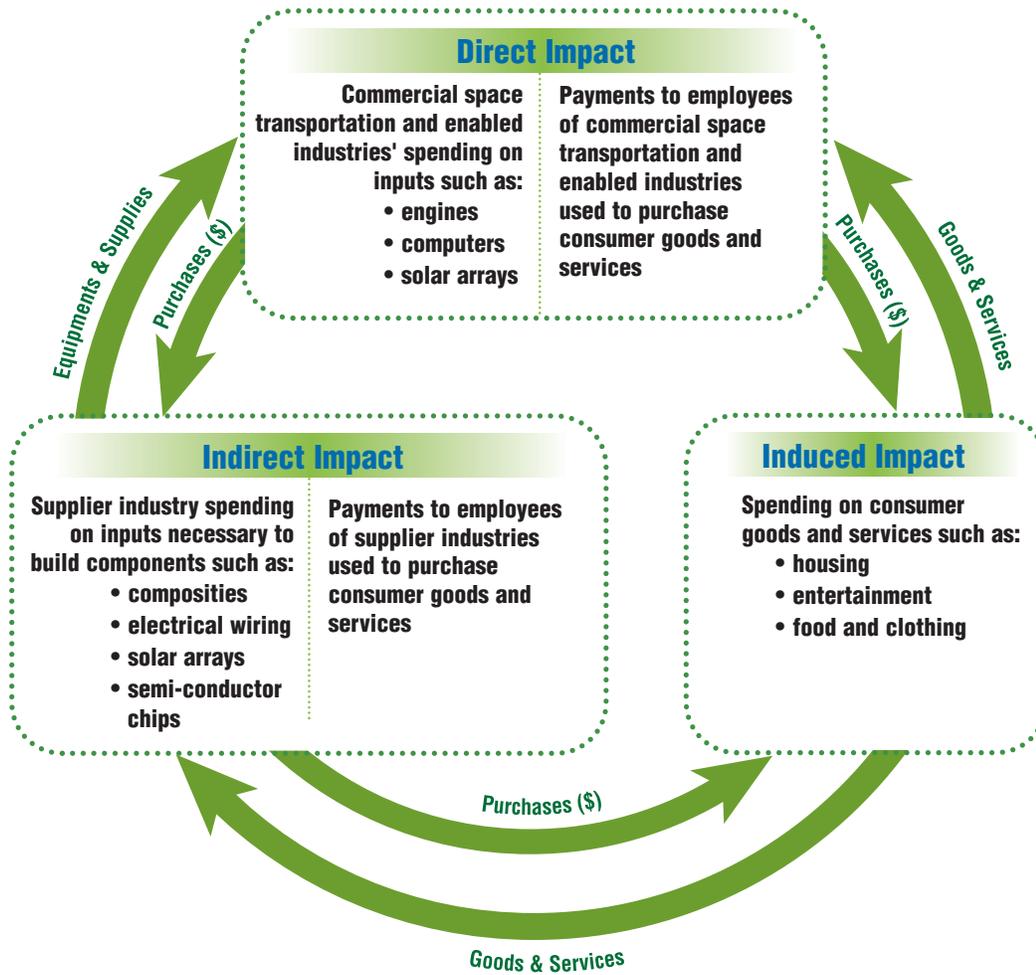


Figure 3: Relationship of Impact Types

4. Economic Activity Impacts

A total of \$139.3 billion in economic activity impacts were created by commercial space transportation and enabled industries in 2006. This section explains the quantity of economic activity impacts and from which industries and sectors the impacts derive. Figure 4 illustrates the total economic impacts generated by commercial space transportation and enabled industries.⁸ The table details the direct, indirect, and induced impacts of economic activity, which when combined, yield the total impact on the U.S. economy.

Industry Group	Direct	Indirect	Induced	Total Impacts
Launch vehicle manufacturing	\$199,195	\$527,028	\$440,500	\$1,166,723
Satellite manufacturing	\$847,992	\$2,240,455	\$1,662,453	\$4,750,900
Ground equipment manufacturing	\$6,898,385	\$18,226,019	\$13,523,993	\$38,648,397
Satellite Services	\$14,530,871	\$41,267,679	\$32,579,181	\$88,377,731
Remote sensing	\$126,804	\$509,190	\$628,429	\$1,264,423
Distribution industries	\$637,662	\$2,261,410	\$2,154,781	\$5,053,854
Total Impacts	\$23,240,911	\$65,031,780	\$50,989,338	\$139,262,027

Figure 4: Economic Activity Impacts of Commercial Space Transportation and Enabled Industries, 2006 (\$000)

The Satellite Services industry includes the six separate service sectors: DARS, DTH TV, mobile satellite telephony, satellite data services, transponder leasing, and VSAT services.

The relative proportion that each of the six primary industries contributed to total economic activity impacts in 2006 is shown in Figure 5. Satellite services and ground equipment manufacturing contributed the largest portions of this activity, comprising 64 percent and 28 percent, respectively, of the total impact.

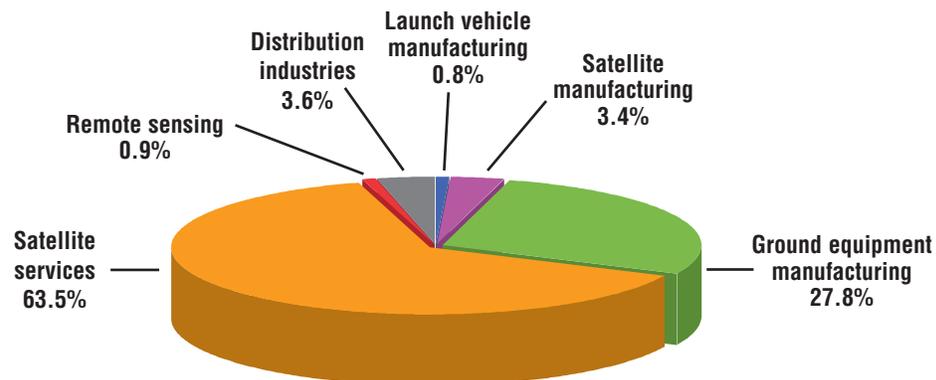


Figure 5: Distribution of Total Economic Activity Impacts Resulting from Commercial Space Transportation and Enabled Industries, 2006.

⁸ Figure 4 consolidates the six separate satellite service sectors seen in Figure 2 into one category.

Based on the results, it appears that the launch vehicle manufacturing industry functions as an enabler of other industries rather than a significant economic activity generator. Over time, commercial launches have placed many satellites in orbit allowing operators to offer a range of satellite services and spurring the growth of ground equipment production to support these satellite services. Commercial launch is essential for maintaining existing satellite services markets and is invaluable for future emerging space markets.

A further breakout of the satellite services portion of economic activity impact is shown in Figure 6. DTH TV was the leading satellite service, accounting for 80 percent of the economic activity generated within the sector. Transponder leasing was the next largest contributor, with nine percent of the total satellite services impact. DARS, a new entry into the sector for this study, created over five percent of the impact, while VSAT services created more than four percent. Data services and mobile satellite telephony comprise the remaining one percent of the total economic activity impact due to satellite services.

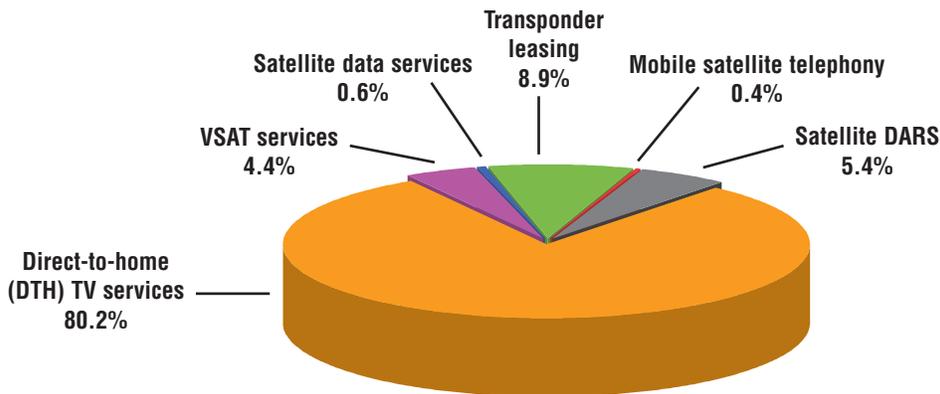


Figure 6: Distribution of Economic Activity Impacts Resulting from Satellite Services Industry Segments, 2006.

5. Most Affected Industries

All RIMS II-designated industry groups are impacted by the activities of the commercial space transportation and enabled industries. Figure 7 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 2006. The industry groups are ranked by the amount of impact on economic activity. Although some of these industry types seem unrelated to commercial space transportation, they are impacted because they provide goods and services, directly or indirectly, to the commercial space industry. Or, the industry group benefits from the spending of earnings on consumer goods, such as household items and leisure activities.

Industry Group	Economic Activity (\$000)	Earnings (\$000)	Employment (Jobs)
Information Services	\$45,341,392	\$10,594,371	155,890
Manufacturing	\$35,304,598	\$6,628,829	94,890
Real Estate and Rental and Leasing	\$9,416,563	\$697,394	18,700
Finance and Insurance	\$6,894,411	\$1,900,361	29,200
Wholesale Trade	\$6,217,235	\$1,998,045	33,850
Professional, Scientific, and Technical Services	\$6,047,037	\$2,646,042	48,470
Health Care and Social Assistance	\$5,071,057	\$2,468,565	61,460
Retail Trade	\$4,308,953	\$1,464,262	59,400
Transportation and Warehousing	\$3,301,363	\$1,147,815	26,420
Other Services	\$3,020,935	\$1,001,026	35,230
Accommodation and Food Services	\$2,568,615	\$982,600	55,540
Management of Companies	\$2,383,767	\$1,177,153	13,730
Administrative and Waste Management	\$2,300,538	\$968,117	37,810
Arts, Entertainment, and Recreation	\$2,013,268	\$775,191	28,390
Utilities	\$1,851,986	\$343,215	3,500
Agriculture, Forestry, Fishing, and Hunting	\$1,275,048	\$186,969	7,890
Educational Services	\$810,927	\$367,544	13,190
Mining	\$651,289	\$127,559	1,500
Construction	\$483,044	\$184,880	4,220
Total	\$139,262,027	\$35,659,935	729,280

Figure 7: Distribution of Economic Activity, Earnings, and Jobs throughout Major U.S. Industry Groups, Generated by Commercial Space Transportation and Enabled Industries, 2006.

In 2006, the *information services* industry was the most affected group in terms of additional economic activity, earnings, and jobs, generating over \$45.3 billion of revenues, over \$10.5 billion in earnings, and creating nearly 156,000 jobs. Information services 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. With an impact of \$35.3 billion in economic activity, \$6.6 billion in earnings, and almost 95,000 jobs the

manufacturing industry group ranked second in 2006. This group includes manufacturing of a wide range of products such as machinery, computer and electronic devices and components (e.g., semiconductor microprocessors and integrated circuits), electrical equipment and appliances (e.g., motors and generators), motor vehicles, textiles and apparel, food and beverages, and paper and plastics. The *professional, scientific, and technical services* industry group experienced an economic impact of approximately \$6 billion in revenues, \$2.6 billion in employee earnings, and around 48,000 jobs. This industry group ranks sixth in economic activity and jobs and ranks third in earnings. The group is composed of legal, accounting, architecture and engineering, advertising, computer system design, technical and management consulting, scientific research and design, specialized design, photographic, and veterinarian services.

Transportation and warehousing industries have a clear role supporting the commercial space transportation and enabled industries. Launch vehicle and spacecraft components must be transported to launch locations and employees need food brought to the grocery stores in which they shop, among numerous other examples. Transportation and warehousing, therefore, experienced \$3.3 billion in economic activity in 2006 as a result of the commercial space transportation and enabled industries, ranking ninth out of 19 industry groups. About \$1.1 billion in earnings and 26,000 jobs were also supported inside the group. Composing this industry group are such services as air, sea, and ground transportation for goods and people, as well as the movement of goods through pipelines, the storage of goods, couriers and messengers (excluding postal service), and support services.



The U.S. federal government has a critical role sustaining commercial space transportation as a customer, investor, and facilitator. As a customer, government purchases of launch services provide a key source of revenue for launch vehicle companies. This action complements revenue from commercial customers and helps maintain industrial capability. In 2006, 13 of the 15 launches of U.S.-built expendable launch vehicles (ELVs) carried U.S. government payloads: eight for the Defense Department and five for NASA. The total estimated value of those launches was over \$600 million. Many of these launches took place using launch vehicles also available for commercial launches.

As an investor, the government 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 IV and Atlas V, which have been used for both commercial and government customers. To aid in the initial development of these vehicles, the Air Force provided \$500 million to each vehicle developer involved when it awarded the initial EELV launch contracts in 1998. The Air Force has provided additional money to support engineering and reliability projects for the EELVs to help compensate for low commercial launch revenue. New small launch vehicles that could serve the commercial market are also being supported by the Defense Department through investment and customer roles. The government also supports the launch industry by building and maintaining launch facilities that are used for both government and commercial launches.

Another role of the federal government is facilitating and promoting private and commercial launch and reentry operations. Facilitation and promotion, along with regulatory, tasks are performed by the FAA/AST to allow for a safe and sustained commercial launch industry in the United States.

The far reaching economic impacts of the commercial space transportation industry are evidenced by effects on the *agriculture, forestry, fishing, and hunting* group. This sector, which ranks 16 out of the 19 industry groups, still experienced \$1.3 billion of economic activity impact as a result of the commercial space transportation and enabled industries. Earnings of approximately \$187 million and over 7,500 jobs also were supported in 2006. The activities in this industry group—none of which have a direct relationship with commercial space transportation—include crop and animal farming, greenhouse and nursery production, forestry and logging, fishing, hunting, trapping, and support services for these activities. Only through indirect and induced relationships are these activities linked to commercial space transportation and enabled industries. Yet there is still a measurable economic impact on this industry group within the U.S. economy.

5.1 JOB IMPACTS

Total employment impacts within the U.S. economy in 2006 totaled 729,000 jobs supported within all industries. The overall job impact trends within the RIMS II industry groups have not significantly changed since the previous study of 2004. *Information services* showed the greatest gain in estimated employment over this timeframe. This expansion is largely due to continued substantial growth in revenues for satellite services, particularly DTH TV, but also is due to a general growth in the information service sector in the U.S. economy. *Accommodation and food services* experienced the second largest growth in jobs impacted from 2004 to 2006.

Comparing the total job impacts resulting from commercial space transportation and enabled industries between 2004 and 2006 shows a significant increase in impacts from 551,000 to 729,000 jobs. This increase correlates with the increases in economic activity and earnings. The increase reversed the loss of impacted jobs between the 2002 and 2004 studies. There was one change among the top five affected industries, in terms of total job impacts, from 2004 to 2006. *Accommodation and food services* replaced *professional, scientific, and technical services* as the fifth most affected industry in terms of jobs. *Information services* and *manufacturing* were the leading two affected industries in both years (see Figure 8).

2004	2006
1 Information Services	Information Services
2 Manufacturing	Manufacturing
3 Health Care and Social Assistance	Health Care and Social Assistance
4 Retail Trade	Retail Trade
5 Professional, Scientific, and Technical Services	Accommodation and Food Services

Figure 8: Top Five Affected Industries in Terms of Total Job Impacts, 2004 and 2006.

5.2 ECONOMIC IMPACTS OF THE LAUNCH VEHICLE MANUFACTURING INDUSTRY

The overall impacts on the U.S. economy by the commercial space transportation and enabled industries in 2006 have been examined. This section examines the

impact of the launch vehicle manufacturing industry, because of its critical role as an enabler of other industries. The launch vehicle manufacturing industry contributes \$1.2 billion in economic activity and approximately 5,700 jobs, or less than one percent of the total economic activity and jobs generated as a result of the commercial space transportation and enabled industries. Figure 9 outlines the various industries directly and indirectly affected by launch vehicle manufacturing.⁹

Industry Group	Economic Activity (\$000)	Earnings (\$000)	Employment (Jobs)
Manufacturing	\$663,305	\$147,560	1,720
Real Estate and Rental and Leasing	\$67,578	\$4,360	130
Finance and Insurance	\$57,355	\$15,974	240
Professional, Scientific, and Technical Services	\$49,801	\$22,438	380
Health Care and Social Assistance	\$43,787	\$21,311	530
Wholesale Trade	\$36,984	\$11,877	200
Retail Trade	\$36,345	\$12,328	500
Information	\$32,737	\$9,058	140
Management of Companies	\$31,684	\$15,635	180
Transportation and Warehousing	\$31,647	\$10,524	240
Accommodation and Food Services	\$22,138	\$8,457	480
Other Services	\$21,912	\$7,254	260
Administrative and Waste Management Services	\$18,379	\$7,667	300
Utilities	\$16,951	\$3,120	30
Agriculture, Forestry, Fishing, and Hunting	\$10,900	\$1,579	70
Mining	\$7,179	\$1,428	20
Educational Services	\$6,765	\$3,044	110
Arts, Entertainment, and Recreation	\$6,728	\$2,744	120
Construction	\$4,548	\$1,729	40
Total	\$1,166,723	\$308,087	5,690

Figure 9: Industries Most Affected by Launch Vehicle Manufacturing Sector, 2006.

In 2006, the *manufacturing* industry group was significantly affected in terms of additional economic activity, earnings, and jobs generated due to launch vehicle manufacturing. This group produced about \$663 million of economic activity, more than \$147 million in earnings, and had approximately 1,700 jobs supported. This constituted 57 percent of total economic activity and 30 percent of total jobs attributable to launch vehicle manufacturing. *Construction* was the least affected group, benefiting from an additional \$4.5 million of economic activity and about 40 new jobs due to launch vehicle manufacturing.

The top input activities to launch vehicle manufacturing by all industry groups consolidated into four categories (*manufacturing, services, transportation and warehousing, and "other"*) are shown in Figure 10. These groups are ranked in order of importance of inputs into launch vehicle manufacturing, with *"other"* constituting a collection of activities embracing wholesale and retail distribution, utilities, construction, extraction industries, and government.

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

Industry Group	Share of Inputs (Total Sector)	Top Subsectors, in Rank Order
<i>Manufacturing</i>	71%	<ul style="list-style-type: none"> · 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
<i>Services</i>	20%	<ul style="list-style-type: none"> · 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
<i>Transportation and Warehousing</i>	3%	<ul style="list-style-type: none"> · 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
<i>Others</i>	6%	<ul style="list-style-type: none"> · 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%	

Figure 10: Top Direct Input Activities to Launch Vehicle Manufacturing, by Major Industry Group

Manufacturing suppliers accounted for 71 percent of total launch vehicle manufacturing inputs. Subsectors providing major inputs to manufacturing include semiconductor and related device manufacturing, gasket and metal valve manufacturing, and forging and stamping industries.

Launch vehicle manufacturers generally purchase supplies in the following categories:

- 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 various interlinked *manufacturing* and *services* suppliers that purchase subsystems, major components, raw materials, services, transportation and warehousing, and other goods and services from firms farther down the chain (see Figure 11). The complete economic impacts result from sales, revenues, and jobs generated at every level of the supply chain as well as from associated household spending.

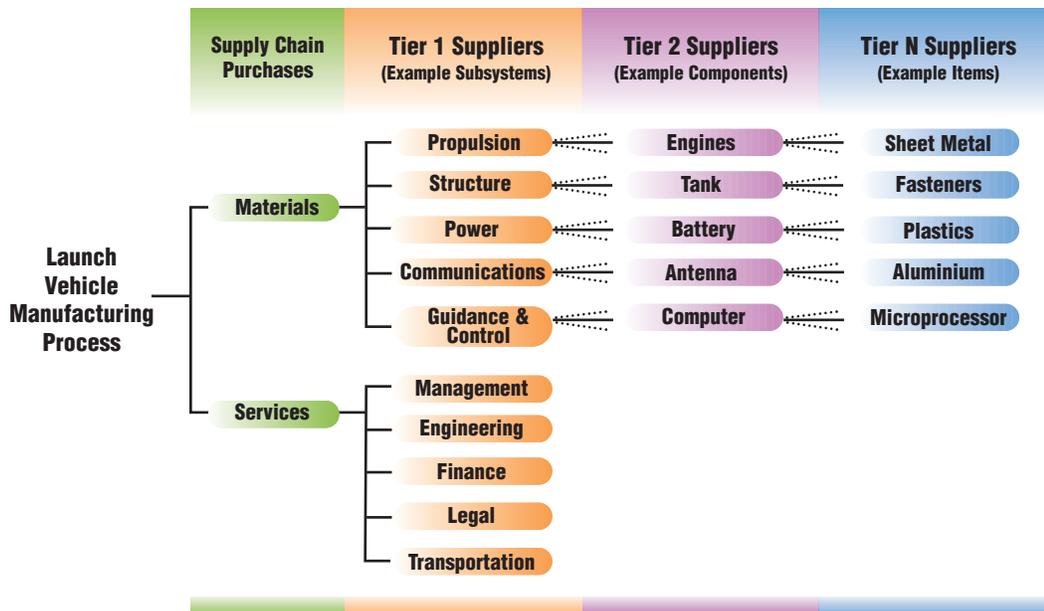


Figure 11: Partial Supply Chain of the Launch Vehicle Manufacturing Industry

The consolidated *service* industry category is the second-highest contributor to launch vehicle manufacturing activity, with 20 percent of total direct inputs. Leading service contributors include 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 inputs have a small, but significant role for the launch vehicle manufacturing industry. This consolidated industry category totals only three percent of inputs and comprises a small share of the related total economic impact from launch vehicle manufacturing activity. Important contributing industries in this category include air transportation, warehousing and storage, water and pipeline transportation, and postal services.

The remaining “*other*” industry category provides minimal inputs to the launch vehicle manufacturing industry by percentage of the total, but still has critical sustaining roles in the launch industry. Contributing activity in this category ranges from wholesale trade, utilities such as power generation and supply, government enterprise, oil and gas extraction, coal mining, and retail trade.



A Day in the Life of a Satellite Services CEO

This hypothetical “day in the life” of a commercial satellite operator CEO (of the notional SAT Inc., a satellite services company) illustrates the widespread economic impacts of routine business activities and purchasing decisions undertaken by the CEO and her supply chain managers. In parentheses are examples of the industries affected by each daily business task. The economic impacts throughout this report result from these types of daily business tasks. Decisions for direct spending on supply chain materials and services, indirect spending on secondary inputs, and induced spending arising from the household expenditures of enabled industry employees all affect the overall economy.

During the morning, a new purchase order to a spacecraft manufacturer is written and delivered by SAT, with hopes to expand bandwidth availability in the next few years (information processing). Human resources address staffing needs, deciding that expansions in teleport and ground control personnel will be followed by the addition of a new supplier relationship consultant (enterprise management services). Revisions to SAT’s health and education benefit package are approved, as the executive management believes that benefits must be improved in order to attract these new personnel (health care, education, and insurance services).

The SAT satellite manufacturer initiates their own internal manufacturing, procurement, and staffing processes as a result of the SAT order, creating business activity across all sectors providing inputs to the satellite services industry. The CEO spends an hour on the telephone with investment experts, exploring new funding opportunities to expand SAT’s physical assets (financial services). She quickly reviews schematics for a new ground control facility in order to accommodate growth in service offerings in new geographical locations (construction and utilities).

At lunchtime, SAT employees take a break to eat at the company cafeteria or to go out to local restaurants (food and beverage services).

The afternoon’s tasks include executive management assessing SAT’s bandwidth demand forecast based upon new commercial and government communications contracts received in the previous quarter. Corporate analysts update the firm’s demand projections, bills of materials, orders to suppliers, and revise capacity scheduling and resource constraints (information processing activity). New suppliers may need to be contacted and evaluated for their planned advanced satellite service capabilities.

The CEO completes her afternoon by attending a preliminary meeting with a commercial launch provider that SAT may choose to launch a new satellite. If a launch contract results, this action will spur economic activity in the launch vehicle manufacturing industry and ripple through the rest of the sectors that directly input into this industry, as well as the rest of the U.S. economy.

At the end of the workday, SAT's employees leave the office. Most go home to their families and friends. They eat dinner (food and beverage purchases), watch television (entertainment services), and pay their bills (financial services). Some go to a ball game (entertainment and recreation) or head to a restaurant for dinner (food services). At the office, the janitorial staff cleans up for the day and a few IT contractors perform routine computer network maintenance (information services).

SAT's satellite services business activities on this busy day have generated new revenue, led to earnings, and supported several jobs for a range of downstream companies. By considering new orders for a satellite, launch, and ground control facility, SAT is setting the stage to generate additional economic activity in service sectors such as manufacturing, information processing, and construction. Consumer spending by SAT employees and supplier companies' employees for food and beverages, health care, and financial services has enlarged the impact of SAT's business activities on the economy. With many other satellite services firms, such as SAT's satellite operator competitors, simultaneously performing similar daily tasks, the economic impact is significantly multiplied across the national network of manufacturing and services suppliers, providing high-value jobs with significant earnings across the nation.



Private entrepreneurial ventures are reshaping the economic profile of commercial space transportation. Private investors along with prize competitions have spurred technological advances with the potential for an even greater space impact on the economy. For example, individuals like Microsoft co-founder Paul Allen, video game developer John Carmack, and hotel entrepreneur Robert Bigelow have invested substantial sums on both launch vehicles and spacecraft.

Figure 12 shows NewSpace flight activity in 2006. Included are milestone events like Bigelow's first launch of its test module. Also included are SpaceX's first launch of its Falcon I rocket, and FAA permitted test flights by both Armadillo Aerospace and Blue Origin.

Flight Date	Operator	Vehicle/System	Launch Site	Flight Type
March 25	SpaceX	Falcon 1	Kwajalein Atoll, Marshall Islands	Orbital
July 12	Bigelow Aerospace	Genesis I	Yasny, Russia	Orbital
October 19	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM	FAA-Permitted Test
October 20	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM	FAA-Permitted Test
October 21	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM	FAA-Permitted Test
October 21	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM	FAA-Permitted Test
October 21	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM	FAA-Permitted Test
November 13	Blue Origin	Goddard (PM 1)	West Texas Launch Site, TX	FAA-Permitted Test

Figure 12: NewSpace Sector Flight Activity, 2006.

In 2004, the \$10 million Ansari X PRIZE pioneered a way which other competitions would follow. More recently NASA's Centennial Challenges, the Google Lunar X PRIZE, and America's Space Prize sponsored by Bigelow Aerospace have drawn widespread attention. NASA's Commercial Orbital Transportation Services (COTS) competition is aimed at encouraging the development of future commercial servicers of the International Space Station by partially funding the development of orbital vehicles that could perform those tasks.

The core commercial space effort promises growth in other traditional businesses like food services and transportation for workers in the commercial space sector. Other impacts reach further into the commercial space transportation world of tomorrow. Those include potential new spaceports, spaceflight training facilities, hangars, and terminals. Organizations such as the Orbital Commerce Project and the National Aerospace Training and Research Center are developing programs to train spaceflight participants. These developments will mean added economic activity as job and derivative business opportunities increase.

The NewSpace sector as a whole is not included in the economic impact analysis for 2006 since its impact at the time was only beginning to emerge and is still developing at the time of this study. Once the companies involved begin collecting customer revenues for their space operations, the sector will be included as part of the economic impact analysis. This practice is similar to that used for the DARS market in the FAA/AST economic impact reports for 2002 and 2004. DARS also did not have sufficient revenue to be included in the impact calculations for several years, but the industry grew and it became a part of the analysis for the first time in this year's report.

6. Comparisons to Past Studies

During the period from 1999 to 2006, the total economic activity impact of commercial space transportation and enabled industries increased 127 percent, the earnings impact grew about 117 percent, and the number of jobs supported rose about 47 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 13 shows the total impact for economic activity, earnings, and jobs.

Total Impact	1999	2002	2004	2006
Economic Activity (\$000)	\$61,313,711	\$95,025,746	\$98,086,960	\$139,262,027
Earnings (\$000)	\$16,431,192	\$23,527,745	\$25,045,888	\$35,659,935
Jobs	497,350	576,450	551,350	729,240

Figure 13: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999, 2002, 2004, and 2006.

6.1 EMPLOYMENT

According to Figure 14, the employment rates from 1999 to 2006 show an overall upward trend with only a slight dip in 2004. This increase in the overall number of jobs over the seven-year period is 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.

Industry Group	Employment (Jobs)			
	1999	2002	2004	2006
Launch vehicle manufacturing	28,620	4,830	8,870	5,690
Satellite manufacturing	57,370	31,260	17,820	22,320
Ground equipment manufacturing	213,080	247,160	162,820	181,550
Satellite services	186,950	278,290	326,960	476,640
Remote sensing	2,820	5,110	5,700	10,060
Distribution industries	8,510	9,800	29,180	32,980
Total Impacts	497,350	576,450	551,350	729,240

Figure 14: Total Employment Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999, 2002, 2004, and 2006

The launch vehicle manufacturing industry experienced a decline in employment impact from 2004 to 2006, while the satellite and ground equipment manufacturing industries recovered some of its losses experienced between 2002 and 2004. The change in jobs is commensurate with the industries' levels of economic activity; there was a reduction in launch vehicle manufacturing and a gain in satellite and ground equipment manufacturing economic activity impacts. The opposite was the case between 2002 and 2004 for launch vehicle manufacturing industry employment. This reverse trend was caused by a change in the RIMS II model. BEA reorganized the overall manufacturing industry group within the model, causing job impacts to decrease between 2002 and 2004 for satellite and ground equipment manufacturing. Like the same enabled industries between 2004 and 2006, remote sensing and distribution industry employment impacts directly correlate with their consistent economic activity impact growth from 1999 to 2006.

6.2 ECONOMIC ACTIVITY

The U.S. launch industry has experienced oscillating amounts of activity during the years studied. The number of FAA-licensed orbital launches rose from six in 2002 to nine in 2004, and dropped back down to six in 2006 (not including one licensed launch for a U.S. Government customer). This oscillation is reflected in the launch vehicle manufacturing economic activity impact numbers for these years, rising in 2004 from 2002 but dropping in 2006. This activity can be seen in Figure 15, which illustrates the industry-by-industry economic impact from 1999 to 2006.

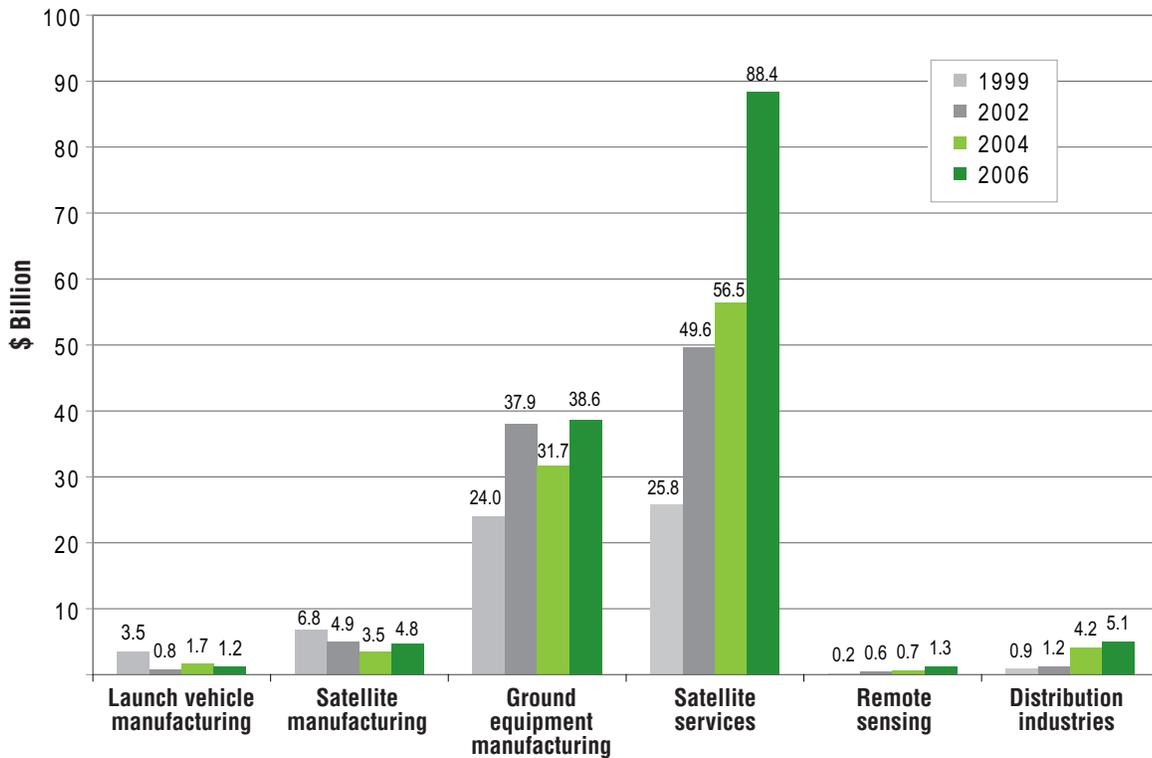


Figure 15: Total Economic Activity Impacts on the U.S. Economy of Commercial Space Transportation and Enabled Industries, 1999, 2002, 2004, and 2006.

Satellite services is the largest industry segment in all three economic impact metrics and has demonstrated a steady record of growth from 1999 to 2006. Figure 16 compares the percentage of economic activity impacts attributable to the different industry segments in 1999 and 2006. Within satellite services, the DTH TV component has been the driving force of growth. Remote sensing and distribution industries also have shown steady increases, while ground equipment manufacturing hit a new impact high in 2006 after decreasing from 2002 to 2004.

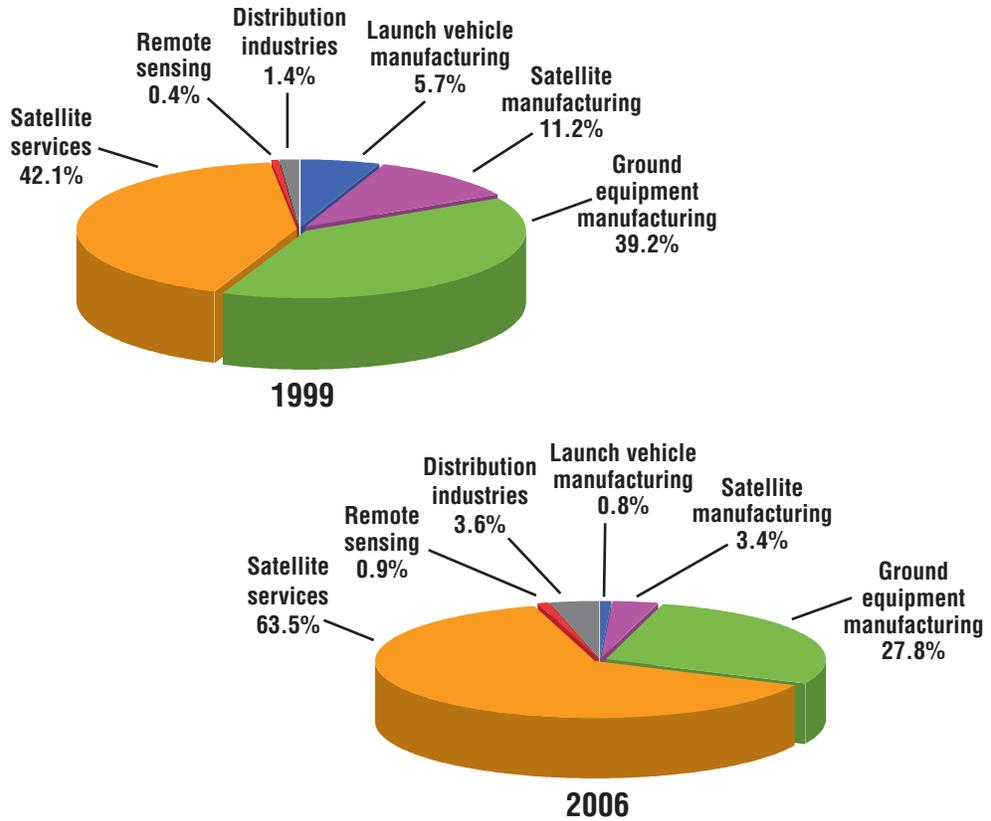


Figure 16: Distribution of Economic Activity Resulting from Commercial Space Transportation and Enabled Industries, 1999 and 2006.



Satellite digital audio radio service (DARS) is now included in the economic impact study as a sector within the satellite services industry. Before 2006, this sector was not included with the other communications services in the overall analysis because the study model is dependent on the revenue recorded by the various industries enabled by commercial space transportation. The economic activity of the two U.S. DARS operators, Sirius Satellite Radio and XM Satellite Radio, was not sufficient to create a significant economic impact upon the U.S. economy in prior years (see Figure 17). But as the DARS customer base has increased, the companies have approached the cash flow breakeven point with higher annual revenues.¹⁰

	Year	Sirius	XM	Total
Number of Subscribers	2006	6,024,555	7,628,552	13,653,107
	2005	3,316,560	5,932,957	9,249,517
	2004	1,143,258	3,229,124	4,372,382
Revenues	2006	\$637,235,000	\$933,417,000	\$1,570,652,000
	2005	\$242,245,000	\$558,266,000	\$800,511,000
	2004	\$66,854,000	\$244,443,000	\$311,297,000
Net Loss	2006	\$1,104,867,000	\$718,872,000	\$1,823,739,000
	2005	\$862,997,000	\$666,715,000	\$1,529,712,000
	2004	\$712,162,000	\$642,368,000	\$1,354,530,000

Figure 17: DARS Company Financial Statistics, 2004 to 2006

Figure 18 shows the satellite DARS economic impact results for 2006. Because this is the first year that the DARS sector is included in the impact analysis, there is economic activity, earnings, and employment added into the satellite services industry, and the overall economy for 2006, that is not comparable with 1999, 2002, and 2004. As revenues continue to increase in the future, there will likely be an even greater impact on the U.S. economy.

Industry Group	Economic Activity (\$000)	Earnings (\$000)	Employment (Jobs)
2006 Satellite DARS Impacts	\$4,815,743	\$1,242,504	26,030

Figure 18: Economic Activity, Earnings, and Job Impacts Resulting from Satellite DARS Industry, 2006.

¹⁰ Sirius Satellite Radio, Inc. 10-K (Annual Report). Filed March 1, 2007 for period ending December 31, 2006. Accessed at <http://www.shareholder.com/Common/Edgar/908937/930413-07-1865/07-00.pdf>. XM Satellite Radio Holdings, Inc. 10-K (Annual Report). Filed March 1, 2007 for period ending December 31, 2006. Accessed at http://media.corporate-ir.net/media_files/IROL/11/115922/reports/10K307.pdf.

7. Industry Comparisons

Commercial space transportation and its enabled industries are not unique in contributing billions to the U.S. economy. Several industries have similar studies calculating their economic impacts. This section compares other national economic impact studies from 2004 to 2006 with the contributions of commercial space transportation in 2002, 2004, and 2006. Figure 19 compares the economic impacts of commercial space transportation alongside other studied industries.

Industry (Year of Impacts)	Economic Activity (\$billions)	Earnings (\$billions)	Employment (Jobs)
Commercial Aviation (2004)	\$1,247	\$380	11,393,000
Travel and Tourism (2006)	\$700	\$177	7,500,000
Wine, Grape, and Grape Products (2005)	\$162	\$33	1,100,000
Commercial Space Transportation and Enabled Industries (2006)	\$139	\$36	729,280
General Aviation (2004)	\$118	\$38	956,000
Commercial Space Transportation and Enabled Industries (2004)	\$98	\$25	551,000
Commercial Space Transportation and Enabled Industries (2002)	\$95	\$24	576,000
Timeshare (2005)	\$62	\$22	565,300
Ethanol (2006)	\$42	\$7	163,000

Figure 19: Comparison of Economic Impacts of Commercial Space Transportation and Enabled Industries and Economic Impacts of Other Industries

Figure 19 Sources:

Commercial Aviation and the American Economy. The Campbell-Hill Aviation Group, Inc. Prepared for the Air Transport Association of America. March 2006.
<http://www.smarts skies.org/NR/rdonlyres/E20C3048-9FD4-46D8-91F1-6303C4148C5A/0/CommercialAviationEconomyMar06.pdf>

“Economic Research: Economic Impact of Travel and Tourism.” Travel Industry Association webpage. May 2007.
http://www.tia.org/researchpubs/economic_research_impact_tourism.html.

“U.S. Wine, Grapes and Grape Products Contribute \$162 Billion to Economy.” Michigan Wines news online. January 17, 2007.
<http://www.michiganwines.com/Media/news/01172007.pdf>.

Economic Impact of the Timeshare Industry on the U.S. Economy. American Resort Development Association Fact Sheet.
http://www.ar da.org/AM/Template.cfm?Section=Press_Kit&Template=/CM/ContentDisplay.cfm&ContentID=7569

Contribution of the Ethanol Industry to the Economy of the United States. Prepared for the Renewable Fuels Association by John M. Urbanchuk, Director, LECG LLC. February 19, 2007.
http://www.ethanolrfa.org/objects/documents/2006_ethanol_economic_contribution.pdf.

The majority of studies selected for comparison use the RIMS II input-output model, while the wine and grape industry and timeshare studies use the IMPLAN model. IMPLAN is a regional input-output economic modeling system, similar to the RIMS II model, which is maintained and sold by a private company. There are differences between the two models, as well as with other available economic impact models, but neither model has distinct advantages over the other for the economic impacts calculated for this report.

Two industries are transportation related: commercial and general aviation. These industries show the place of commercial space transportation in relation to other FAA-related aviation activity. Commercial space transportation and enabled industries' economic activity impacts fall between those two aviation types, with commercial aviation significantly higher than all other compared industries. General aviation has slightly lower impacts in terms of economic activity, but higher impacts in terms of jobs and earnings, compared to the impacts of this study.

There are also non-transportation industries included in this comparison. Commercial space transportation and enabled industries has a greater impact on the U.S. economy than the timeshare and ethanol industries combined, while the travel and tourism industry economic impact dwarfs that of commercial space transportation. Interestingly, the wine, grape, and grape product industry has an economic impact just slightly higher in terms of economic activity and job impacts, but is lower in earnings impact.

8. Emerging Markets for Future Consideration

In the coming years, commercial space transportation will likely enable new industries that have yet to develop. As with the current enabled industries, these new industries will lead to measurable impacts within the U.S. national economy. In addition, both existing and emerging industries will help sustain a robust U.S. launch market to provide suborbital and orbital launch opportunities. Examples of some of these emerging industries include:

8.1 PUBLIC SPACE TRAVEL

Public space travel, or space tourism, is projected to become a significant revenue-producing industry in the foreseeable future. Market studies have shown that space tourism could become a billion-dollar industry within 20 years. From 2001 to present, five people have made a flight to the International Space Station, traveling to the orbital destination on a Russian spacecraft. Las Vegas-based Bigelow Aerospace is developing inflatable orbital habitats that could be used for tourist trips. Bigelow and a few other organizations are sponsoring various space prize competitions that could help spur public space travel.

Vehicles that could serve both orbital and suborbital space tourism markets are being actively developed by several companies. Moreover, space tourism may provide the initial market for suborbital vehicles that also can serve other markets, including point-to-point travel, microgravity research, remote sensing, and fast package delivery. 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.

8.2 ADVANCED REMOTE SENSING APPLICATIONS

Space-borne remote sensing by government and commercial operators has provided an important view of Earth for decades. But as data management technology and remote sensing end-user technologies evolve to provide next-generation value-added 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.

8.3 HIGH-BANDWIDTH AND BROADBAND DATA SERVICES

Demand for broadband Internet access and other high-bandwidth data services continue to grow, both in the U.S. and worldwide. Information and communication applications continue to require higher bandwidth solutions from terrestrial and satellite providers. For some people it is difficult to obtain service from terrestrial providers, particularly in rural areas with limited infrastructure. A new generation of broadband communications satellites planned for launch over the next several years could solve this "last mile" problem and provide broadband access to all potential users, in much the same way as DTH TV provides an alternative to cable television. If these ventures are successful it may prompt the development of additional satellite systems, further supporting the commercial space transportation industry.

Appendix A: Methodology

METHODOLOGY OVERVIEW

This study uses 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) 2006 Satellite Industry Annual Indicators Study.¹¹

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 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 by 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 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.

¹¹ The data collected from the SIA survey have been re-categorized to accommodate industry definitions determined to be appropriate for this report. Revenue data may differ from that reported by SIA.

TYPES OF ECONOMIC IMPACTS

Economic impacts are measured here in three ways: economic activity, earnings, and jobs. Economic activity, earnings, and job 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. For example, the purchase of one launch vehicle will stimulate economic activity, increase earnings, and support jobs in other industry groups. However, because all these impacts are based on the same change in final demand, they cannot be added together.

RIMS II

For this study, economic impacts were derived using 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 comprises 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.

Between 2002 and 2004, the RIMS II model was modified, affecting the estimated outputs in revenue, earnings, and job impacts during this period. The industry coding system moved from Standard Industrial Classification (SIC) to 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 the manufacturing sector, such as publishing and management, have been reclassified under the services sector. NAICS also recognizes a new information services sector. Further, the 2004 RIMS II revision included an update of the model's five-year national benchmark data. Use of more recent input-output statistics 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.

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, earnings, and employment. Further calculations were used to derive the direct, indirect, and induced effects of economic activity. Figure A1 illustrates this methodology.

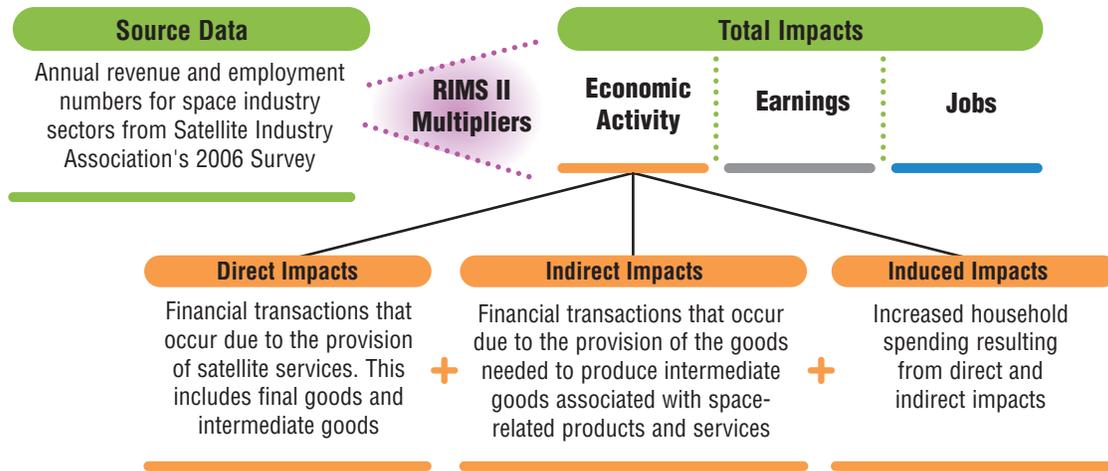


Figure A1: Simplified Methodology for Using RIMS II

Appendix B: Selection of Industries for Analysis

RIMS II input-output (I-O) codes are based on NAICS codes. The NAICS codes selected were those that were most closely 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.

NAICS code	NAICS Description	I-O Code	I-O Description	SIA Industry Segment
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
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
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
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

Figure B1: Selected North American Industry Classification System (NAICS) and Input-Output (I-O) Codes for Satellite Industry Association (SIA) Industry Segments

NAICS code	NAICS Description	I-O Code	I-O 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>	Satellite 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
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>	Satellite Digital Audio Radio Service
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

Figure B1: Cont'd

Appendix C: Frequently Asked Questions

What constitutes commercial space transportation?

Commercial space transportation includes space launches deemed to be commercial under one of the following definitions:

- 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, Chapter 701.

What are enabled industries?

The commercial space transportation industry provides access to space for a range of industries that could not exist without that access. These industries are considered *enabled* by commercial space transportation. The enabled industries include commercial space industries: launch vehicle, satellite, and ground equipment manufacturing; satellite services; remote sensing; plus related distribution industries. Government-related space activity is not related in the enabled industries. Enabled industry revenue is used to determine overall commercial space transportation economic impacts.

The overall economic impact growth is significant over the previous study. Is there a reason for this positive growth?

The primary reason for the sustained growth in economic activity is revenue growth within the satellite services industry, particularly in DTH TV revenue. In 2006, satellite services created \$88.4 billion in economic activity impacts; in 2004, satellite services created \$56.5 billion.

What does the employment impact measure?

The total calculated impact on employment measures the amount of jobs throughout the entire economy that are supported by commercial space transportation, the enabled industries, and jobs in all other economic sectors. This measure includes direct, indirect, and induced impacts. Therefore, this measure is much more than jobs in the launch industry or even the larger space industry. It includes jobs in all manufacturing, service, and distribution industries.

Why are GPS and GPS-related products and services not included in the analysis?

The Global Positioning System is a positioning, navigation, and timing satellite system developed for and operated by the United States Department of Defense. Because GPS is a military system that does not use commercial space transportation, it is not included as part of commercial space transportation and commercial satellite activity. Therefore, GPS devices that are enabled by the military GPS system are not included in this analysis, either.

What regions within the United States see the most economic activity?

This study is of the national-level economy; it does not examine economic impacts at the regional or local level. The RIMS II economic model multipliers used to calculate impacts from revenue inputs are for the U.S. national economy only. So, economic activity cannot be deduced for a particular region or locality within the United States according to the calculated impacts in this study.

Does this report take into account foreign investment or foreign company activity?

This report primarily includes economic activity that falls within the U.S. national economy. The Satellite Industry Association revenue data is categorized to exclude non-U.S. launch, satellite, and ground equipment manufacturer and customer activity. Sea Launch, though owned by multinational entities, conducts its launch preparation from U.S. territory and is licensed by FAA/AST, so its revenues are considered within this study.