Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the 1st quarter 2004 and forecasts for the 2nd quarter 2004 and 3rd quarter 2004

Quarterly Report Topic:

Overview of the U.S. Launch Industry Workforce

2nd Quarter 2004

United States Department of Transportation • Federal Aviation Administration
Associate Administrator for Commercial Space Transportation
800 Independence Ave. SW • Room 331
Washington, D.C. 20591

Introduction

The Second Quarter 2004 Quarterly Launch Report *features launch results from the first quarter of 2004 (January-March 2004) and launch forecasts for the second and third quarters of 2004 (April-September 2004). This report contains information on worldwide commercial, civil, and military orbital space launch events. Projected launches have been identified from open sources, including industry references, company manifests, periodicals, and government sources. Projected launches are subject to change.*

This report highlights commercial launch activities, classifying commercial launches as one or both 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 the Associate Administrator for Commercial Space Transportation of the Federal Aviation Administration under 49 United States Code Subtitle IX, Chapter 701 (formerly the* Commercial Space Launch Act)

Contents

Cover: A Zenit 3SL, marketed by Boeing Launch Services and launched by the multi-national consortium Sea Launch, sends Loral Skynet do Brasil's Estrela do Sul on its way to geosynchronous orbit on January 10, 2004 from the central Pacific Ocean.

First Quarter 2004 Highlights

In January, President Bush announced a new space initiative for NASA focused on robotic and human exploration. The plan's highlights include completing the International Space Station (ISS) by 2010 and increasing the responsibility of international partners for the station, retiring the Space Shuttle in 2010, developing a Crew Exploration Vehicle (CEV) for orbital and extra-orbital flights to be introduced in 2008 with the first crewed flight no later than 2014, and a human landing on the Moon as early as 2015 but no later than 2020. As part of the plan, new robotic lunar exploration vehicles will begin visiting the Moon in 2008. No firm timetable was provided for a crewed mission to Mars.

Space Adventures, Ltd. confirmed its third space tourist to fly on a Russian Soyuz spacecraft to the ISS will be American Gary Olsen, who owns and runs Sensors Unlimited, Inc. He is scheduled to fly in April 2005 or possibly as early as October this year during an ISS crew switch.

The NASA-Orbital Sciences Corporation (OSC) Hyper-X X-43A reached a world record speed for a vehicle operating in the Earth's atmosphere, reaching Mach 7 on March 27, 2004. It was the second flight of the US$250 million research project as part of work on hypersonic engines.

NASA cancelled Boeing's RS-84 reusable rocket engine initiated under the agency's cancelled Space Launch Initiative (SLI), as well as the X-43C scramjet hypersonic flight test program, because they were not tied to President Bush’s new Space Exploration Initiative.

ISC Kosmotras signed a marketing agreement with Germany-based SpaceTech GmbH. SpaceTech will market commercial launches of the Ukrainian-Russian Dnepr launch vehicle for European and Asian customers. The agreement grants SpaceTech exclusive rights on a number of prospective ESA and DLR missions. Another marketing partner is U.S.-based ATK Thiokol.

Rosaviakosmos was disbanded and its aviation sector returned to the Russian government's Transport Ministry. A new Federal Space Agency inherited the country's civil space programs under the Ministry of Industry and Energy. Russian President Vladimir Putin appointed General Anatoli Perminov to replace former Rosaviakosmos head Yuri Koptev.

An explosion in a solid propellant booster building at India's Shriharikota Launch Center on February 23, 2004, killed at least six people and injured 12 more. The Indian Space Research Organization (ISRO) said the fire at the Solid Propellant Booster Plant at Shriharikota was caused when fuel propellant in a motor caught fire as technicians were removing a plate in a casting assembly.

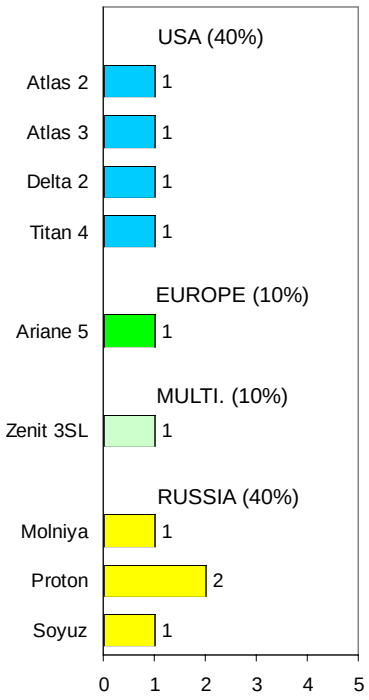
NASA has cancelled the Orbital Space Plane (OSP), notifying contractors to stop work as development begins on the CEV. The new CEV, however, is expected to retain many design elements developed for OSP.

The European Space Agency (ESA) will pay Russia US$152 million to upgrade the Soyuz booster for launches from Kourou, French Guiana, where a new launch pad is being built with an additional US$361 million in funding from ESA. France is bearing half of the costs. The first launch is scheduled for 2006.

The November 2003 failure of a Japanese H-2A launch vehicle was apparently caused by a solid booster casing breach, which allowed hot gases to burn though the nozzle of one of the solid rocket boosters during ascent. This subsequently prevented the booster's pyrotechnic separation, resulting in increased loads, lack of thrust, and flight path deviation.

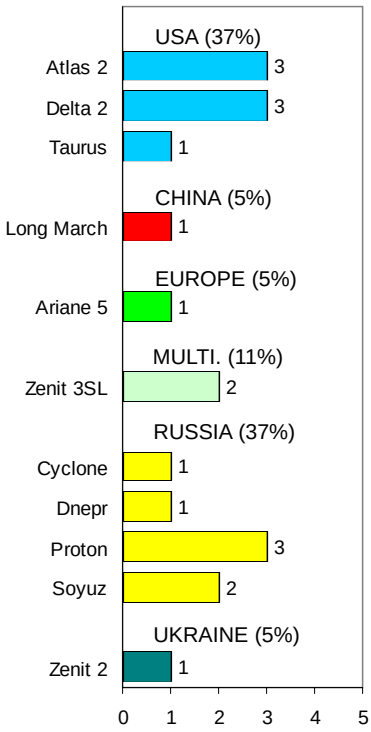
Vehicle Use
(January – September 2004)

Figure 1: First Quarter 2004 Total Launch Vehicle Use



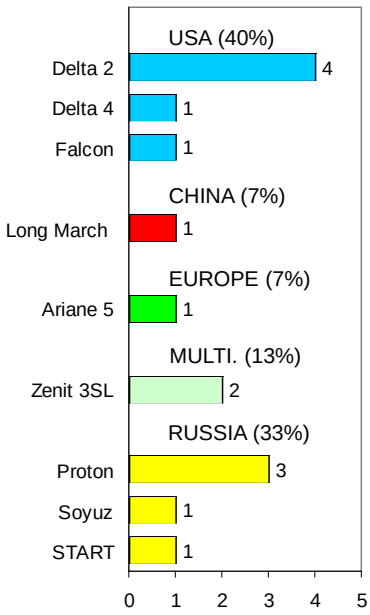
Total = 10

Figure 2: Second Quarter 2004 Total Projected Launch Vehicle Use



Total = 19

Figure 3: Third Quarter 2004 Total Projected Launch Vehicle Use



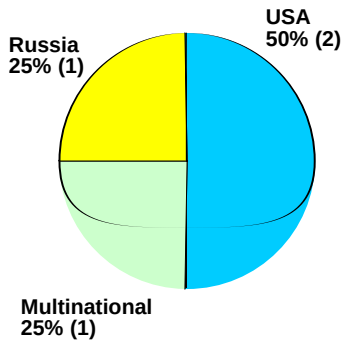
Total = 15

Figures 1-3 show the total number of orbital launches (commercial and government) of each launch vehicle and resulting market share that occurred in the first quarter of 2004 and that are projected for the second and third quarters of 2004. These launches are grouped by the country in which the primary vehicle manufacturer is based. Exceptions to this grouping are launches performed by Sea Launch, which are designated as multinational.

Note: Percentages for these and subsequent figures may not add up to 100 percent due to rounding of individual values.

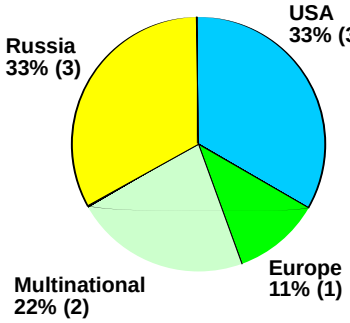
Commercial Launch Events by Country
(January – September 2004)

Figure 4: First Quarter 2004 Commercial Launch Events by Country



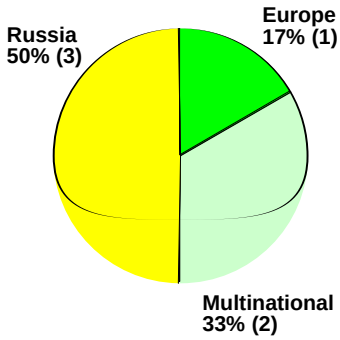
Total = 4

Figure 5: Second Quarter 2004 Projected Commercial Launch Events by Country



Total = 9

Figure 6: Third Quarter 2004 Projected Commercial Launch Events by Country

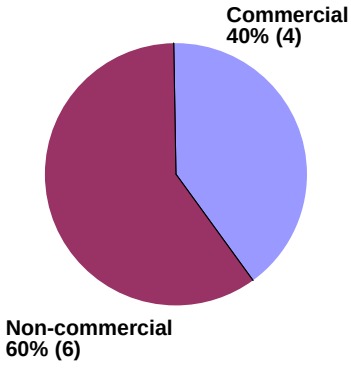


Total = 6

Figures 4-6 show all *commercial* orbital launch events that occurred in the first quarter of 2004 and that are projected for the second and third quarters of 2004.

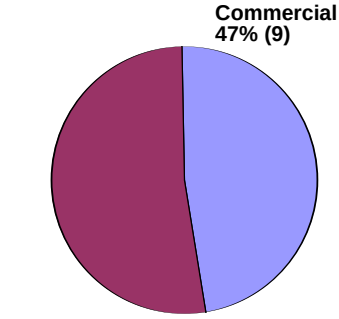
Commercial vs. Non-commercial Launch Events
(January – September 2004)

Figure 7: First Quarter 2004 Commercial vs. Non-commercial Launch Events



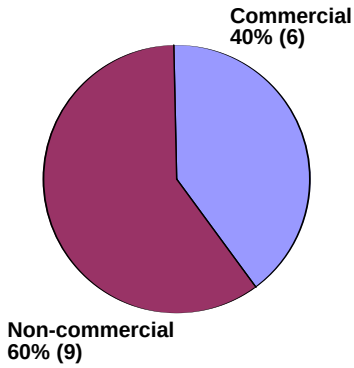
Total = 10

Figure 8: Second Quarter 2004 Projected Commercial vs. Non-commercial Launch Events



Total = 19

Figure 9: Third Quarter 2004 Projected Commercial vs. Non-commercial Launch Events

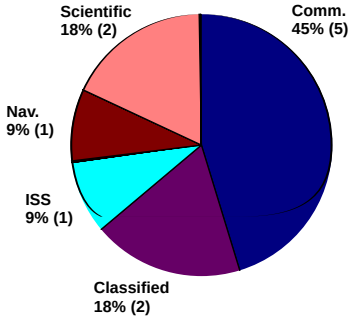


Total = 15

Figures 7-9 show commercial vs. non-commercial orbital launch events that occurred in the first quarter of 2004 and that are projected for the second and third quarters of 2004.

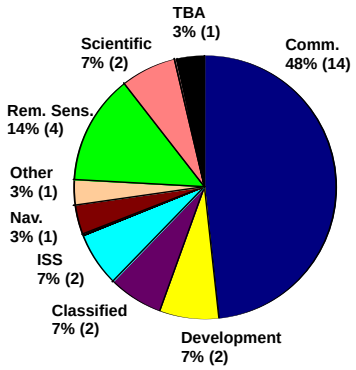
Payload Use
(January – September 2004)

Figure 10: First Quarter 2004 Payload Use



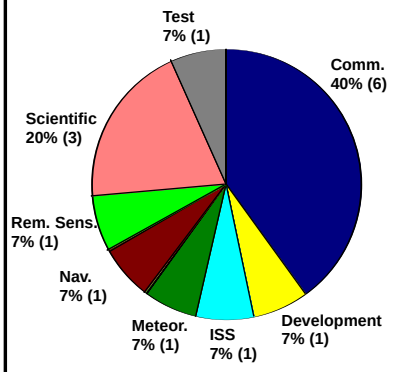
Total = 11

Figure 11: Second Quarter 2004 Projected Payload Use



Total = 29

Figure 12: Third Quarter 2004 Projected Payload Use

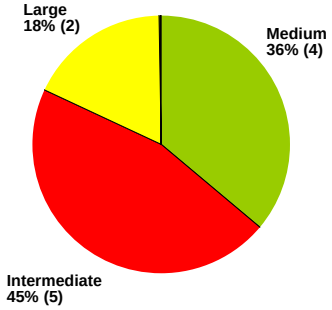


Total = 15

Figures 10-12 show total payload use (commercial and government), actual for the first quarter of 2004 and that are projected for the second and third quarters of 2004. The total number of payloads launched may not equal the total number of launches due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle.

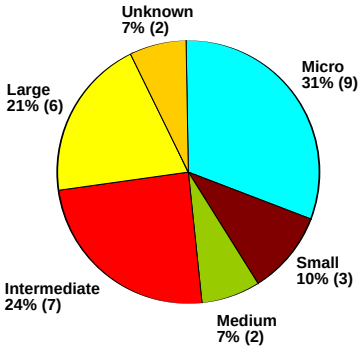
Payload Mass Class
(January – September 2004)

Figure 13: First Quarter 2004 Payload Mass Class



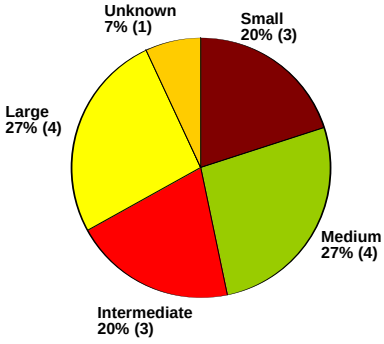
Total = 11

Figure 14: Second Quarter 2004 Projected Payload Mass Class



Total = 29

Figure 15: Third Quarter 2004 Projected Payload Mass Class

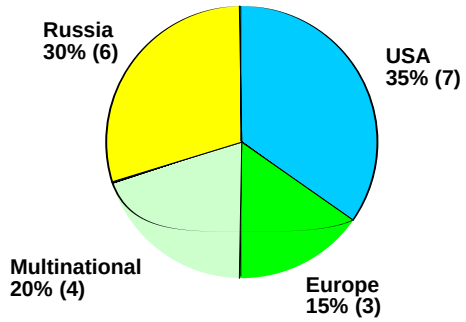


Total = 15

Figures 13-15 show total payloads by mass class (commercial and government), actual for the first quarter of 2004 and projected for the second and third quarters of 2004. The total number of payloads launched may not equal the total number of launches due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle. Payload mass classes are defined as Micro: 0 to 91 kilograms (0 to 200 lbs.); Small: 92 to 907 kilograms (201 to 2,000 lbs.); Medium: 908 to 2,268 kilograms (2,001 to 5,000 lbs.); Intermediate: 2,269 to 4,536 kilograms (5,001 to 10,000 lbs.); Large: 4,537 to 9,072 kilograms (10,001 to 20,000 lbs.); and Heavy: over 9,072 kilograms (20,000 lbs.).

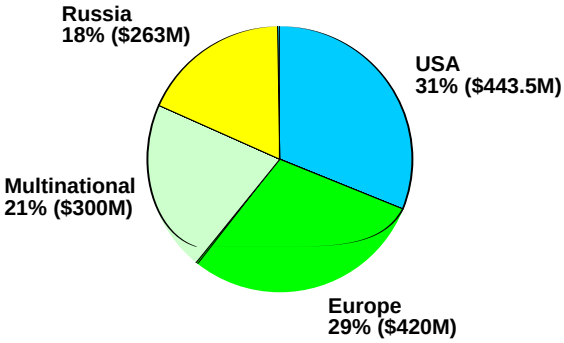
Commercial Launch Trends
(April 2003 – March 2004)

Figure 16: Commercial Launch Events, Last 12 Months



Total = 20

Figure 17: Estimated Commercial Launch Revenue, Last 12 Months



Total = $1,426.5M

Figure 16 shows commercial launch events for the period April 2003 to March 2004 by country.

Figure 17 shows estimated commercial launch revenue for the period April 2003 to March 2004 by country.

Figure 18: Commercial Launch Events by Country, Last Five Years

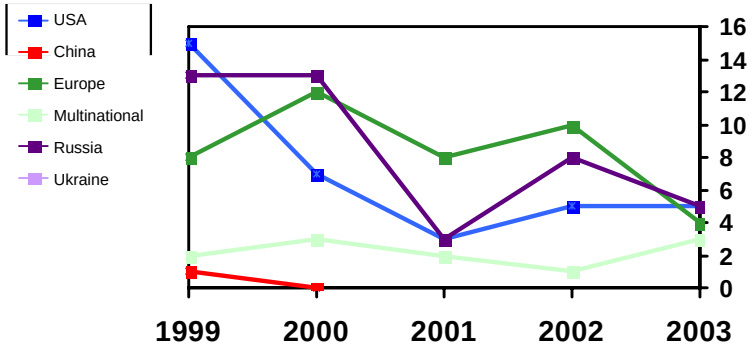


Figure 18 shows commercial launch events by country for the last five full years.

Figure 19: Estimated Commercial Launch Revenue (in $ million) by Country, Last Five Years

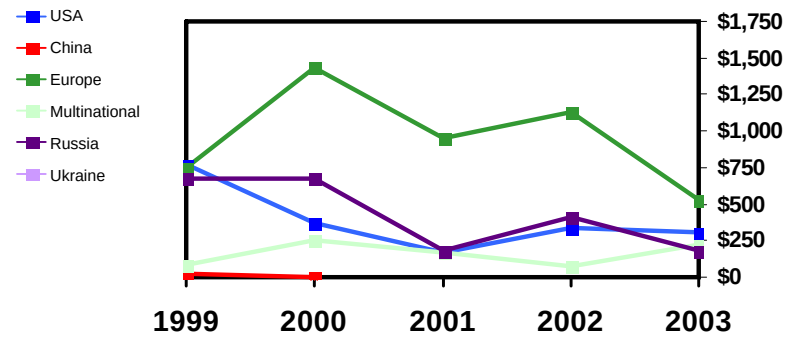


Figure 19 shows estimated commercial launch revenue by country for the last five full years.

Overview of the U.S. Launch Industry Workforce

Introduction

In recent years, government and industry leaders have focused increasingly on the need to attract and retain aerospace workers. The urgency has been due in part to the criticality of the aerospace industry to the national infrastructure and its security. The Commission on the Future of the U.S. Aerospace Industry found in its final report of November 2002 that the United States had lost more than 600,000 scientific and technical aerospace jobs in the past 13 years.[1] There is also an overall aging of the aerospace workforce, which risks the loss of experience and intellectual capital. The launch vehicle manufacturing sector of the aerospace industry has also suffered a decline in employment as a result of the reduced demand for launches and related operations.

President Bush's new space exploration initiative, announced January 14, 2004, will lead to new growth for the launch industry as options are sought for new space transportation to the Moon and beyond low-Earth orbit. A large number of retirements are expected at a time when new government initiatives focused on space exploration, responsive space access, and missile defense are ramping up. Commercially, there are several efforts to develop low-cost reusable launch vehicles with the intention of sparking a new space market for passenger travel. According to Business Week, commercial space ranks among the Top Five innovative industries that could drive the next job boom.[2] Included among those industries are biotechnology, telecommunications, nanotechnology, and energy. However, new launch jobs will not materialize overnight, and U.S. launch vehicle manufacturing and operations employers will likely continue to feel the effects of decreasing demand.

The educational system must prepare potential new workers for the prospect of future jobs in space launch. Young people have not been attracted to aerospace because there is a perception that aerospace-related jobs do not pay as well as those in the information technology, software, and other computer-related industries. Software publishers, Internet content publishers, Internet service and web portal providers, data processors, web hosting, and computer systems designers earn about $61,000 per year. Aerospace engineers earn an average of $79,270 per year.[3] Therefore, it is important to correct the false perception that pursuing such careers is not worthwhile in order to attract the best and brightest students to fill future industry needs.

Scope and Purpose of Report

A comprehensive and accurate understanding of the current size of the launch industry is useful for monitoring the downward trend of the launch workforce. The Associate Administrator for Commercial Space Transportation (AST) has prepared this Special Report to quantify the number of workers currently participating in various aspects of launch vehicle manufacturing and operations. The goal of this report is to show how the launch industry fits into the overall aerospace industry in terms of number of employees and to provide a baseline from which future launch workforce assessments can be measured. A clearer picture of the launch workforce among the broader aerospace workforce may show a close relationship with the downward trend of launch activity or perhaps yield similar cause-and-effect relationships with other industry indicators. Ultimately, this data may serve as the foundation from which to analyze the workforce problems currently plaguing the launch industry and hopefully be used as a guidepost for the way ahead to a growing industry.

The report is the first attempt by AST to present the size of the orbital launch industry in the United States in terms of personnel. The scope of analysis for this report is limited to the U.S. orbital launch industry, which includes launch vehicle manufacturers, launch vehicle component manufacturers, launch service providers, and operations at launch sites. The Sea Launch company is included as a launch service provider because U.S.-based Boeing is the majority shareholder and AST licenses its launches, but the Zenit 3SL is a Ukrainian-built launch vehicle.

The approach for gathering employment data from U.S. launch manufacturers, service providers, and subcontractors, was to compile information from existing public reports and Web sites, as well as request information directly from the companies. Due to the small number of companies involved in the industry and its highly competitive nature, an effort has been made to protect proprietary data by presenting only aggregate calculations.

Speaking directly with company representatives yielded the best and most accurate data to use in this report, so extra effort was taken to ensure that the amount of data from company contacts was maximized. In general, data on employees and revenue are either not publicly available, or are wrapped in with other loosely related or unrelated information.

In addition, labor and industry categories for space do not yet exist in national-level accounts, so analysts need to derive space industry statistics from the larger categories of aerospace, engineering, manufacturing, and others. The Aerospace Industries Association and the Bureau of Labor Statistics (BLS) compile employment statistics and trends for the guided missiles, space vehicles, and parts segment.

Despite the known limitations, this special report succeeds at quantifying the space launch workforce in terms of launch vehicle manufacturing, subcontractors, launch service providers, and launch site operations, based primarily on data provided by the participating companies.

Overview of the U.S. Orbital Launch Industry

In 2003, the U.S. launch vehicle and missile industry employed approximately 70,400 people, 15,300 of which were involved in the manufacturing of launch vehicles, guided missiles, vehicle components, and related parts.[4] These numbers represent the lowest levels since 1990, with a decrease of 42 percent overall and 29 percent in the manufacturing sector.[5]

Of the 15,300 employees, an estimated 5,000 are directly involved as prime contractors in the manufacture of orbital launch vehicles for commercial and government (civil and military) launches (see Table 1). Based on these two figures, an estimated 10,300 people are employed as subcontractors, providing components like engines, guidance systems, and other hardware to prime contractors. Also included in this number are people producing components for guided missiles. Some 13,500 military, civilian, and contractor personnel are employed to operate and maintain Air Force launch ranges, where most orbital launches are conducted. Excluding NASA, about 500 people are dedicated to the provision of launch services. They are employed by Sea Launch, International Launch Services, Boeing Launch Services, Orbital Sciences Corporation, and Space Exploration Technologies Corporation. Approximately 1,700 people are employed by the National Aeronautics and Space Administration (NASA) at Kennedy Space Center (KSC) in Florida to support Space Shuttle launches.

Table 1. U.S. employees dedicated to launch manufacturing and services for commercial, civil, and military launch in 2004 (multiple sources).[1]

U.S. Space Industry Sector	Estimated Number of Employees
Prime contractors manufacturing orbital launch vehicles*	5,000
Subcontractors providing engines, guidance systems, and other hardware*	10,300
Manufacturing Subtotal	***15,300***
Launch ranges*	13,500
Launch service providers (excluding NASA)**	500
NASA employees at Kennedy Space Center***	1,700
Launch Services Subtotal	***15,700***
U.S. Launch Industry Total	***31,000***

* Includes support for commercial and civil/military government launches.

** Commercial launch support only.

*** Government launch support only.

[1] This chart includes total employment devoted to commercial, civil and military launch in the U.S. Private employers categorize their launch manufacturing and operations workforce by vehicle rather than by commercial or government launch support. Most launch vehicles serve both the commercial and civil/military government markets.

AST released a report in March 2004 that quantifies the economic impacts of the commercial space transportation and enabled industries on all other U.S. industry sectors. More specifically, the report shows that purchases of commercial launch vehicles and launch services in 2002 contributed to the employment of 4,828 people in the launch vehicle manufacturing and services industry and all other industries throughout the economy. However, the number of jobs was derived from revenue data and represents not only the number of jobs in the launch industry itself, but also the jobs created in all industries affected by activity in the launch industry in 2002. Revenue data used to calculate the economic impact, earnings and number of jobs is recorded exclusively from commercial launches in 2002. Therefore, the number of jobs recorded by the economic impact study from launch manufacturing and services and other industries is smaller than the totals in Table 1, which include workers supporting commercial and civil/military government launches, as well as government employees. Consequently, this special report is intended to provide further insight into the actual size of the launch workforce.

The same report shows that those employees in the launch vehicle manufacturing and services industry and all other industries affected by launch industry activity in 2002 earned approximately $206.3 million and generated economic activity on the order of $792 million for the launch industry and all other industries throughout the economy.

The following sections highlight areas of the space industry that together provided some of the numbers discussed in the overview. For purposes of this report, the space industry is divided into four sectors: launch vehicle manufacturers, subcontractors, launch service providers, and spaceport operations.

The U.S. Orbital Launch Industry in Detail

The U.S. orbital launch industry as discussed in this report includes those companies dedicated to manufacturing launch vehicles, providing subcomponents for those vehicles, offering launch services, and conducting range operations.

Launch Vehicle Manufacturing and Subcontractors

Approximately 5,000 people dedicated to the manufacture of orbital launch vehicles are employed in the United States.

The current suite of U.S. orbital launch vehicles is manufactured by four major companies: The Boeing Company, Lockheed Martin Corporation, Orbital Sciences Corporation (OSC), and new to the business in 2002, Space Exploration Technologies Corporation (SpaceX). The Boeing Company builds the Delta 2 and Delta 4 launch vehicles, both of which include several mission-dependent variants and can be launched from Cape Canaveral Air Force Station (CCAFS) and Vandenberg Air Force Base (VAFB). Depending on the variant, the Delta vehicles use solid strap-on boosters called graphite epoxy motors (GEMs) provided by ATK Thiokol, the only major provider of solid motors in the United States today. A further discussion on ATK Thiokol and other subcomponent providers follows in the next section.

Lockheed Martin Space Systems produces the Atlas line of vehicles by drawing together employees from several of the company's key locations in California, Colorado, and Louisiana. The Atlas 5 Common Core Booster (CCB) is manufactured in Lockheed Martin's Denver plant, while the Centaur upper stage of the Atlas is produced in San Diego. The External Tank (ET) used for the Space Transportation System (STS) is manufactured at Lockheed Martin Michoud in Louisiana, then shipped by barge to NASA's Kennedy Space Center, Florida. Depending on the Atlas 5 mission, solid boosters manufactured by Aerojet are used to supplement the vehicle's first stage thrust.

Orbital Sciences Corporation (OSC) manufactures the Pegasus XL and Taurus at the company's Launch Systems Group in Chandler, Arizona. The Minotaur is integrated at VAFB with support from OSC's

Chandler location.

SpaceX, based in El Segundo, California, manufactures the Falcon line of vehicles.

Some 10,300 people are employed across the country to provide components and subcomponents to the prime contractors responsible for building launch vehicles. Examples of some of the major subcontractors include Aerojet, ATK Thiokol, Goodrich, CMC Electronics Cincinnati, Honeywell, and Pratt & Whitney.

Launch Service Providers

Approximately 500 people are involved in launch operations. This figure does not include Air Force range personnel or NASA KSC employees, which are discussed in detail later in this report.[6]

There are seven major orbital launch service providers in the United States today: Boeing Launch Services (BLS), International Launch Services (ILS), Lockheed Martin, OSC, Sea Launch, SpaceX, and NASA. Lockheed Martin provides Titan 4B launches (one remains) for the Air Force, and NASA is responsible for launching the Space Shuttle from KSC. The other organizations provide commercial launch services to private and government clients. Most orbital launches take place from CCAFS in Florida and VAFB in California. However, OSC occasionally provides launches from Wallops Space Flight Center in Virginia, and Kwajalein Atoll in the Pacific Ocean. Sea Launch conducts launch operations from an equatorial point in the Pacific Ocean. SpaceX is new to the commercial launch sector, and is expected to conduct its inaugural launch during the fall of 2004 from VAFB.

Spaceport Operations

The United States Air Force manages launch range operations at the Eastern Range (consisting of the Wallops Flight Center and Virginia Space Flight Center, NASA's Kennedy Space Center, the Air Force's Cape Canaveral Air Force Station, facilities operated by the Florida Space Authority, and other assets located throughout the Atlantic Ocean region) and the Western Range (VAFB, facilities operated by the California Space Authority, and Alaska's Kodiak Island). This responsibility is assigned by Air Force Headquarters to the Air Force Space Command, which in turn is delegated to the 14th Air Force, headquartered at VAFB, California.

Range operations fall under two space wings within the 14th Air Force. The 45th Space Wing, based at Patrick Air Force Base in Florida, is responsible for the Eastern Range, and the 30th Space Wing is responsible for the Western Range out of VAFB. The 45th SW range operations are supported by the efforts of 11,000 military personnel, civilians, and contractors. For Western Range operations, the 30th SW counts on 1,500 military personnel, civilians, and contractors.[7] The Florida Space Authority employs about 20 people who, among other responsibilities, conduct orbital and suborbital commercial launches from time to time. The Alaska Aerospace Development Corporation (AADC), which operates a commercial spaceport on Kodiak Island, employs about 17 people.

About 1,700 NASA employees are based at KSC to launch the Space Shuttle. Before launch, however, KSC counts on two major organizations to prepare the Space Transportation System, or Shuttle, and integrate special payloads. The Space Shuttle orbiters are processed by personnel employed by United Space Alliance (USA), a joint company formed in 1996 by Boeing and Lockheed Martin to facilitate streamlined Space Shuttle operations on the ground. USA also provides staff for Shuttle launch pad operations, specifically to conduct ordnance checks and pre-launch pad inspections. The joint company employs approximately 10,000 people located in Texas, Florida, Alabama, California, and Washington, DC.[8] These employees are accounted for within both manufacturing subcontractors and launch range operations in Table 1.

Texas-based SPACEHAB provides payload integration services for launch providers located at CCAFS and VAFB, as well as

space-related educational products. The company also supports, through its Astrotech Space Operations subsidiary acquired in 1997, Sea Launch operations. SPACEHAB itself provides pressurized habitat modules for the Space Shuttle, while Astrotech provides commercial payload processing services for launch providers located at CCAFS and VAFB. In June 2003, SPACEHAB employed 258 people.

Conclusions

The number of employees working in the U.S. aerospace industry has been declining over the past 10 years, reaching the lowest level in over 50 years in 2003. While demand for aerospace engineers in recent years has been relatively low, other industries, such as those related to computer software, have attracted young, technically trained graduates because jobs in these fields are plentiful. The low demand is only half the picture, however, as a growing number of aerospace workers are retiring, a situation expected to increase in coming years. The result is a "deflation" of U.S. aerospace expertise, and not enough newly trained aerospace workers to "inflate" the industry in response. As the United States sits poised to enter a new era in air and space technology and operations, this situation strikes many as alarming. It should be noted that the annual decline has slowed somewhat since 1996 (see Figure 1).

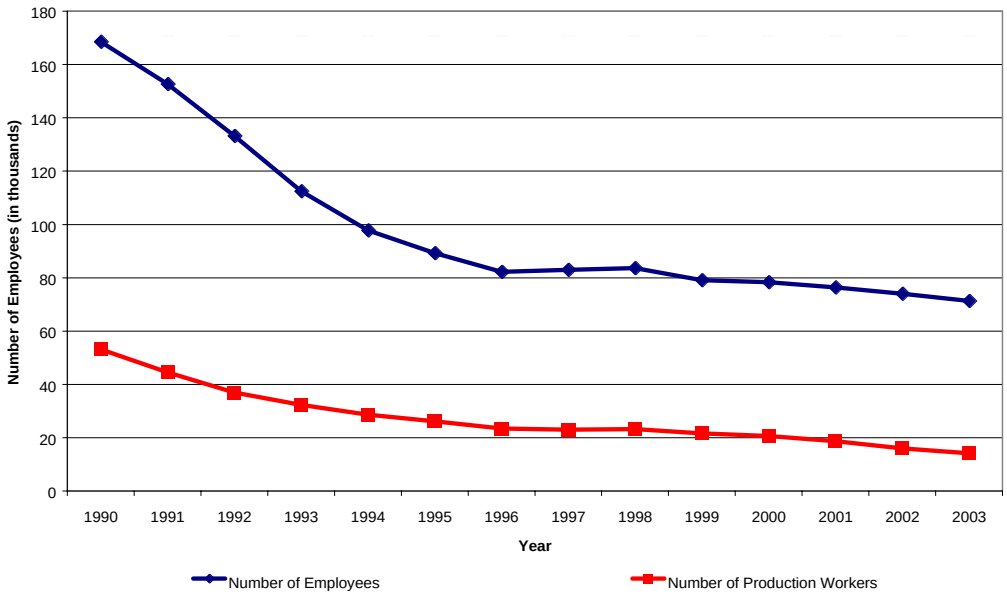


Figure 1. Number of U.S. employees dedicated to guided missiles, space vehicles, and parts (1990-2003). **Source:** Aerospace Industries Association.

Figure 1 shows a well-publicized story, that of the declining number of employees in the guided missiles, space vehicles, and parts sector of the industry. This report has provided the launch industry with a data point of 31,000 total employees in early 2004, broken down by smaller sectors. This number is an important baseline for subsequent studies focused on the launch industry workforce.

Endnotes

1 Commission on the Future of the U.S. Aerospace Industry, Final Report of the Commission on the Future of the U.S. Aerospace Industry, November 2002.
2 "Productivity: Who Wins, Who Loses: The U.S. is reaping big - but uneven - gains from its highly efficient workforce," Business Week, March 22, 2004.
3 Department of Labor, Bureau of Labor Statistics, 2002 National Industry-Specific Occupational Employment and Wage Estimates.
4 "Aerospace Related Employment (revised)," Aerospace Daily & Defense Report, April 14, 2004, page 7.
5 Ibid.
6 Data gathered from SEC 10-K filings and interviews.
7 14th Air Force website (www.peterson.af.mil/hqafspc), accessed April 19, 2004, specifically fact sheets for the 45th Space Wing and 30th Space Wing.
8 USA website (www.unitedspacealliance.com), accessed April 19, 2004.

First Quarter 2004 Orbital Launch Events

Date			Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price	L	M
1/10/04	√	+	Zenit 3SL	Odyssey Launch Platform	*	Estrela do Sul	Loral Skynet do Brasil	Communications	$65-85M	S	S
1/29/04			Soyuz	Baikonur		Progress ISS 13P	Rosaviakosmos	ISS	$65M	S	S
2/5/04	√	+	Atlas 2AS	CCAFS	*	AMC 10	SES Americom	Communications	$65-75M	S	S
2/14/04			Titan 4B/IUS	CCAFS		DSP 22	USAF	Classified	$350-450M	S	S
2/18/04			Molniya	Plesetsk		Kosmos 2405	Russian MoD	Communications	$30-40M	S	S
3/2/04			Ariane 5G	Kourou		Rosetta Orbiter	European Space Agency (ESA)	Scientific	$125-155M	S	S
						Philae	ESA	Scientific			S
3/13/04	√	+	Atlas 3A	CCAFS	*	MBSAT	Mobile Broadcasting Corp.	Communications	$65-75M	S	S
3/16/04	√		Proton M	Baikonur	*	Eutelsat W3A	Eutelsat	Communications	$70-100M	S	S
3/20/04			Delta 2 7925-10	CCAFS		Navstar GPS 2R-11	USAF	Navigation	$45-55M	S	S
3/27/04			Proton K	Baikonur		Kosmos 2406	Russian MoD	Classified	$60-85M	S	S

√ Denotes commercial launch, defined as a launch that is internationally competed or FAA-licensed.

\+ Denotes FAA-licensed launch.

* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.

L and M refer to the outcome of the Launch and Mission (immediate status of the payload upon reaching orbit): S = success, P = partial success, F = failure

Note: All launch dates are based on local time at the launch site at the time of launch.

Second Quarter 2004 Projected Orbital Launch Events

Date		Vehicle	Site	Payload or Mission	Operator	Use	Vehicle Price
4/12/04		Long March 2C	Taiyuan	TBA	China - TBA	TBA	$20-25M
				Tansuo 1	Harbin Institute of Technology	Remote Sensing	
4/15/04	√	+ Atlas 2AS	CCAFS	* Superbird 6	Space Communications Corp.	Communications	$65-75M
4/19/04		Soyuz	Baikonur	Soyuz ISS 8S	Russian Federal Space Agency	ISS	$65M
4/19/04		Delta 2 7920	VAFB	Gravity Probe B	NASA	Scientific	$45-55M
4/22/04	√	+ Taurus XL	VAFB	Rocsat 2	National Space Program Office (NSPO)	Remote Sensing	$20-30M
4/25/04		Zenit 2	Baikonur	Kosmos 2407	Russian MoD	Classified	$30-45M
4/26/04		Proton K	Baikonur	* Express AM11	Russian Satellite Communciation Co.	Communications	$60-85M
5/2/04	√	Zenit 3SL	Odyssey Launch Platform	* DirecTV 7S	DirecTV, Inc.	Communications	$65-85M
5/19/04	√	+ Atlas 2AS	CCAFS	* AMC 11	SES Americom	Communications	$65-75M
5/19/04		Soyuz	Baikonur	Progress ISS 14P	Russian Federal Space Agency	ISS	$65M
6/4/04		Delta 2 7925-10	CCAFS	Navstar GPS 2R-12	USAF	Navigation	$45-55M
6/10/04	√	Proton M	Baikonur	* Intelsat 10 02	Intelsat	Communications	$70-100M
6/17/04		Delta 2 7920	VAFB	Aura	NASA	Remote Sensing	$45-55M
6/24/04		Atlas 2AS	CCAFS	NRO A4	USAF	Classified	$65-75M
6/24/04	√	Dnepr 1	Baikonur	Demeter	Centre National d'Etudes Spatiales (CNES)	Scientific	$8-11M
				* AKS 1	Aerospace Systems	Development	
				AMSat-Echo	Amateur Radio Satellite Corp.	Communications	
				* Celestis 5	Celestis, Inc.	Other	
				* Latinsat 3	Aprize Satellite	Communications	
				* Latinsat 4	Aprize Satellite	Communications	
				Saudisat 3	Space Research Institute	Communications	
				Saudisat 4	Space Research Institute	Communications	
				Saudisat 5	Space Research Institute	Communications	
				Unisat 3	University of Rome	Development	
6/2004	√	Proton M	Baikonur	* Amazonas 1	Hispasat	Communications	$70-100M
6/2004		Cyclone 2	Plesetsk	Sich 1M	Ukraine Space Agency (NKAU)	Remote Sensing	$20-25M
2Q/2004	√	+ Zenit 3SL	Odyssey Launch Platform	* Spaceway 1	Hughes Network Systems	Communications	$65-85M
2Q/2004	√	Ariane 5G	Kourou	* Anik F2	Telesat Canada	Communications	$125-155M

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\+ Denotes FAA-licensed launch.

* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity. Note: Ariane 5 payloads are usually multi-manifested, but the pairing of satellites scheduled for each launch is sometimes undisclosed for proprietary reasons until shortly before the launch date.

Third Quarter 2004 Projected Orbital Launch Events

Date		Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price
7/3/04		Delta 4 Heavy	VAFB		Delta 4 Heavy Demosat	USAF	Test	$140-170M
7/20/04		Long March 2C	Taiyuan		Double Star Polar	Chinese National Space Administration	Scientific	$20-25M
7/28/04		Soyuz	Baikonur		Progress ISS 15P	Russian Federal Space Agency	ISS	$65M
7/30/04		Delta 2 7925-10	CCAFS		Messenger	NASA	Scientific	$45-55M
7/2004	√	Ariane 5 ECA	Kourou	*	XTAR EUR	XTAR	Communications	$125-155M
8/2004		Proton K	Baikonur	*	Express AM1	Russian Satellite Communciation Co.	Communications	$60-85M
8/2004	√	Proton M	Baikonur	*	AMC 15	SES Americom	Communications	$70-100M
9/1/04		Delta 2 7320	CCAFS		Swift	NASA/GSFC	Scientific	$45-55M
9/15/04		Delta 2 7320	VAFB		NOAA N	NOAA	Meteorological	$45-55M
9/2004		Delta 2 7925-10	CCAFS		Navstar GPS 2R-13	USAF	Navigation	$45-55M
3Q/2004	√	+ Zenit 3SL	Odyssey Launch Platform	*	APStar 5	APT Satellite Co., Ltd.	Communications	$65-85M
3Q/2004	√	START 1	Svobodny	*	EROS B1	Imagesat International N.V.	Remote Sensing	$7-10M
3Q/2004	√	Proton M	Baikonur	*	Worldsat 2	SES Americom	Communications	$70-100M
3Q/2004		Falcon	VAFB		Tacsat 1	USAF	Development	$6M
3Q/2004	√	+ Zenit 3SL	Odyssey Launch Platform	*	Intelsat Americas 8	Intelsat	Communications	$65-85M

√ Denotes commercial launch, defined as a launch that is internationally competed or FAA-licensed.

+ Denotes FAA-licensed launch.

* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity. Note: Ariane 5 payloads are usually multi-manifested, but the pairing of satellites scheduled for each launch is sometimes undis closed for proprietary reasons until shortly before the launch date.