



# THE SPACE REPORT



2008



The Authoritative Guide to Global Space Activity

THE  
**SPACE**  
REPORT

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EXECUTIVE  
SUMMARY

The Authoritative Guide to Global Space Activity

## Introduction

*The Space Report 2008: The Authoritative Guide to Global Space Activity* presents a rich and far-reaching look at developments over the past year in the space industry, one of the most dynamic and innovative sectors of the global economy. Now in its third year, the book serves as a telescope, peering further each year into



As the fourth planet from the Sun, Mars is a potential location for the next round of human exploration after the Moon. There are 5 vehicles currently exploring the planet. The orbiters 2001 Mars Odyssey, Mars Express, and the Mars Reconnaissance Orbiter are observing the planet from above. The rovers Spirit and Opportunity are surveying the terrain on the surface. Both the European Space Agency (ESA) and NASA have plans to send human expeditions to Mars sometime after 2030. *Image Credit: NASA/JPL-CalTech*

the growing space industry universe to help readers see and understand more about its people, systems, operations, and societal benefits. Seeking to inform and educate a broad readership, from industry experts to government officials to researchers and investors, the report offers both detailed statistical analysis and forward looking assessments. *The Space Report 2008* ranges broadly from satellite communications and the people who launch, operate, and finance the hardware, to the exploration of the Moon and Mars. It depicts an industry characterized by innovation, expansion, and opportunity.

Our detailed research into government programs, market trends, and the overall economic impact of worldwide space activity shows an industry expanding beyond its

traditional base and aggressively pursuing new and growing business lines. With 11 percent growth in 2007 and global revenues exceeding \$251 billion, space emerges as a place of rich international cooperation in exploration and scientific endeavor, as a possible arena for military competition, and as the locus of strong growth. Space industries are important economic engines, providing hundreds of thousands of jobs at wages far above the U.S. national average and fueling development of new products and services that can drive economies and change and benefit our daily lives.

Government demand for satellite communication and ground-imaging platforms, as well as development in military arenas, such as missile defense, indicate that the long-standing base of the space industry — government investment and spending — is secure and will continue to be for years to come. Cooperative effort toward completing the International Space Station (ISS) and plans for ambitious manned and unmanned space exploration of the Moon, Mars, and beyond indicates steady and robust government involvement in space.

*The Space Report 2008* also elaborates on the dynamic growth in the space industry's commercial sector. Booming interest in global positioning technology, and industry's rapid expansion of the array of products and services using this technology, have delivered impressive market results. Satellite radio and direct-to-home (DTH) television service are also contributing to substantial growth in the space industry. Private exploration of space by entrepreneurs and adventurers who invest significant personal funds represents an industry sector in its infancy, that could in the near future reach a turning point toward significant development.



A surveyor records the location of an endangered tree using a Sokkia GIR1600 wearable GPS receiver and a PDA with geographic information systems software. Global positioning services are the most dynamic and visible applications of space infrastructure today. *Image Credit: Sokkia*

## The Space Report 2008 Data

*The Space Report 2008* is the result of extensive research by the Space Foundation, The Tauri Group, ISDR Consulting, Content First, and George Washington University's Space Policy Institute. It is accomplished through gathering, analyzing, and synthesizing publicly



available sources, ranging from government reports and congressional records to data provided by industry trade associations and private research firms. Data sources also include articles in mainstream business and industry publications. In several cases, international budget data comes directly from the respective embassy sources. This demonstrates the commitment of *The Space Report 2008* contributors to clarity, credibility, transparency, and completeness. References and sources are cited, in nearly 450 endnotes, to direct readers to additional information about the industry.

Accompanying the text of *The Space Report 2008* are dozens of exhibits tracking industry sector growth, major sources of space industry revenue, trends in government investment in space, and market performance

of space industries. Additional exhibits that further illuminate the state of the global space industry can be found at [www.TheSpaceReport.org](http://www.TheSpaceReport.org).

Due to the publication schedule, the methodology for this report is somewhat different than previous editions. *The Space Report 2008* is being published earlier in the year to provide more timely data for readers. As a result, certain sources were unavailable at the time of publication. In those instances, flagged to readers in comments and footnotes, we have included estimates or analyses from prior-year data. When multiple sources of data are available, we report the information and then select the most appropriate estimates to build an overall summary of total economic space activity. We also alert the reader to the differing methodologies underlying some of the estimates that appear in this report and instances in which key data may be missing. The following sections summarize the key findings in each chapter.

### Center image

This dramatic image of the Orion Nebula offers a peek inside a cavern of rolling dust and gas where thousands of stars are forming. More than 3,000 stars of various sizes appear in this image, from the massive, young stars that are shaping the nebula to the pillars of dense gas that may be the homes of budding stars. Some stars are still young enough to have disks of material encircling them. These disks are called protoplanetary disks or "proplyds" and are too small to see clearly in this image. The disks are the building blocks of solar systems. The Orion Nebula is 1,500 light-years away, the nearest star-forming region to Earth. Astronomers used 520 Hubble images, taken in five colors, to make this picture. They also added ground-based photos to fill out the nebula. Image Credit: NASA, ESA, M. Robberto (Space Telescope Science Institute/ESA) and the Hubble Space Telescope Orion Treasury Project Team

A 70-meter antenna, known as DSS-14 "Mars," is located at the Goldstone Deep Space Communications Complex, located in California's Mojave Desert. The dish reflector and its azimuth-elevation mount atop the concrete pedestal weigh nearly 2,970 tons (2.7 million kilograms). The antennas of NASA's Deep Space Network provide a host of functions from tracking and controlling spacecraft, to debris monitoring, to scientific research. Image Credit: NASA/JPL-Caltech



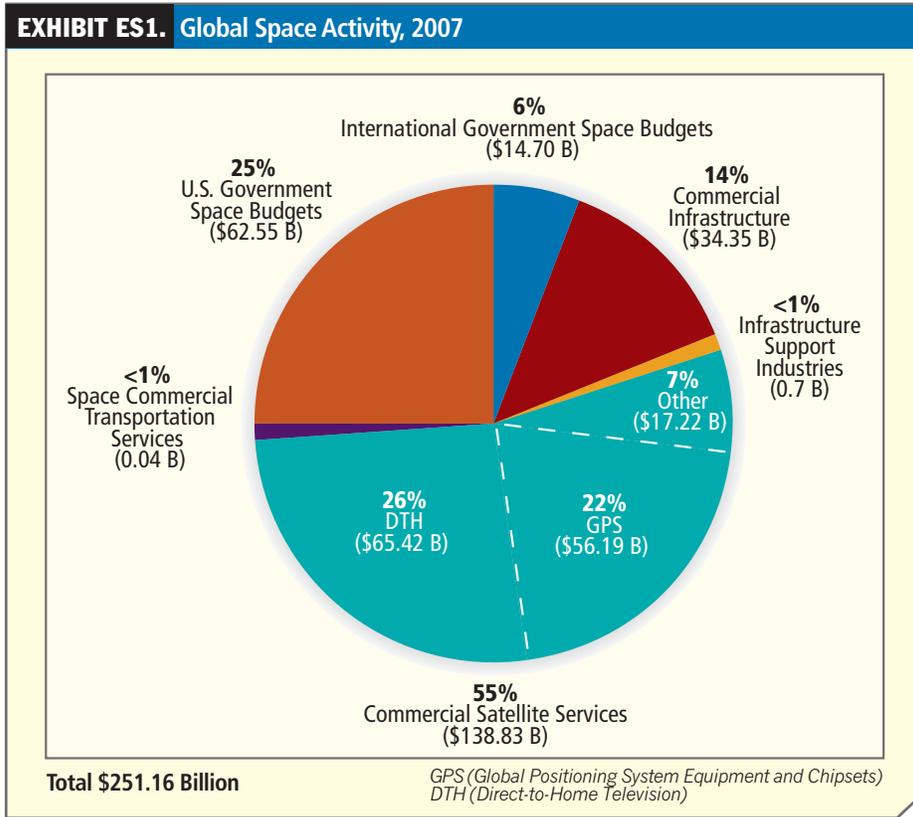
## 1.0 | The Space Economy

The extensive research contained in this report points to one overriding conclusion: The space industry is a growing and important component of the world economy. Using a standard

conservative methodology, *The Space Report 2008* estimates that global space revenue from government and private sources reached \$251 billion in 2007, a strong growth rate of 11 percent over 2006. More than three-quarters of global space economic activity stemmed from purchases of commercial satellite-based products and services (55%) and U.S. government spending (25%). Activity in two commercial satellite services, DTH Television and Global Positioning System (GPS) equipment and chipsets, drove robust space industry growth. These are the two largest sub-segments of the space industry and they also posted two of the strongest growth numbers.

The Aeronomy of Ice in the Mesosphere (AIM) spacecraft undergoes solar array deployment tests. AIM is the first satellite mission dedicated to the study of mysterious iridescent polar clouds that form 50 miles above Earth's surface. Image Credit: NASA/Orbital Sciences Corporation

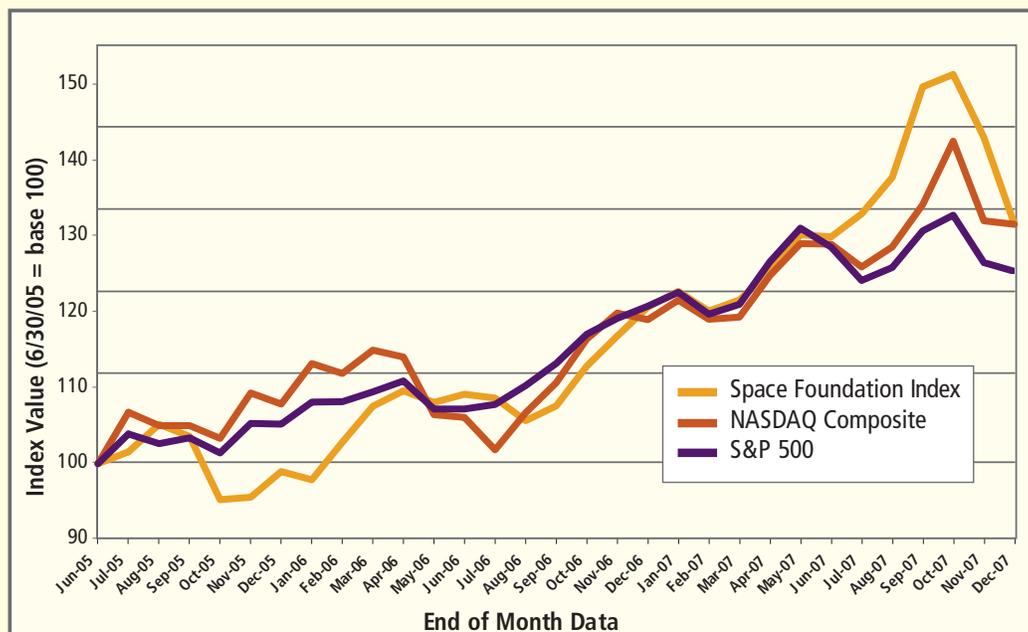
**EXHIBIT ES1. Global Space Activity, 2007**



DTH services grew nearly 19 percent in 2007 while sales of GPS equipment grew 20 percent, together contributing nearly \$20 billion in economic activity to the global economy. Total revenue for space products and services in 2007 is estimated at \$138.83 billion, an increase of approximately 20 percent over 2006.

Satellite manufacturing revenue increased 14 percent overall to an estimated \$13.64 billion. This growth was driven by a 26 percent increase in revenue for government payloads, to \$11.41 billion. Ground equipment was the largest growth sector of space infrastructure in 2007, increasing approximately 6.5 percent over 2006. Revenue from ground equipment related to space operations is estimated at \$30.68 billion in 2007.



**EXHIBIT ES2. Space Foundation Index Performance vs. Other Market Indices**

### The Space Foundation Index (SFI)

To track the space industry's dynamic growth, the Space Foundation Index, now in its third year, has become an important barometer for investors of companies heavily involved in providing space-related products and services. From its inception in June 2005, through December 2007, this weighted index reports 29 percent growth in the combined market performance of 31 public space-related companies, on pace with the NASDAQ Composite Index and outpacing the S&P 500 Index, which grew by 23 percent. The SFI outpaced the S&P 500 over the first three quarters of 2007 and the NASDAQ Composite in the first and third quarters. The SFI, like many other market indices, declined by 11.4 percent in the fourth quarter of 2007, due to overall public equity market factors as well as stock price declines in particular SFI companies. Nevertheless, the Index grew by 8.4 percent in 2007, significantly better than the 3.5 percent growth of the S&P 500, but less than the 9.8 percent posted by the NASDAQ Composite.

**EXHIBIT ES3. Space Foundation Index Returns vs. Benchmarks**

RETURNS PERIOD	SFI	S&P 500	DIFF	NASDAQ COMPOSITE	DIFF
Since SFI Inception	28.98%	23.25%	5.72%	28.94%	0.03%
CY 2006	20.08%	13.62%	6.46%	9.52%	10.56%
CY 2007	8.43%	3.53%	4.90%	9.81%	-1.38%
1Q07	0.71%	0.18%	0.53%	0.26%	0.45%
2Q07	6.38%	5.81%	0.57%	7.50%	-1.12%
3Q07	14.23%	1.56%	12.67%	3.77%	10.45%
4Q07	-11.40%	-3.82%	-7.57%	-1.82%	-9.58%



At the XM Broadcast Operations Center in Washington, D.C., a shift supervisor monitors 100 digital satellite radio stations of specialized music, news, and sports. *Image Credit: Michael Moran*

## 2.0 | Space Products and Services

The space industry is enabling an ever expanding array of space products and services that are changing the way people go about their daily lives. Satellite-related products and services, many of which did not exist just a few years ago, form the largest portion of the space industry, driven primarily by the use of communications and positioning satellites.

Commercial communications satellites provide services to both fixed and mobile ground receivers, from television sets in the home to global positioning units in automobiles. Fixed satellite services generally include voice and data communications, as well as DTH.

Positioning services are delivering growth, both in terms of the number of applications and the amount of revenue they generate. ABI Research, a technology market research firm, reports that revenue from GPS equipment and integrated chipsets grew from approximately \$37.5 billion in 2005 to \$56.2 billion in 2007. Demand for in-vehicle navigation devices has seen “unprecedented levels of activity and growth in 2007,” according to ABI. In-vehicle navigation devices are the revenue driver, accounting for approximately 60 percent of all GPS equipment revenue in 2006.

The importance of GPS services to space industry growth is hard to overstate. This sector of the industry is so dynamic that some advocates of GPS services refer to positioning data as the “fifth utility,” comparing its importance to such essentials as water, gas, electricity, and telecommunications. In-car navigation devices can work in multiple ways, helping a driver pinpoint his own location on the road, or helping a vehicle’s owner track the car in cases where it has been stolen. GPS units are tracking mobile groups of people for safety or coordination, the same way they have been tracking assets and fleets. For instance, some manufacturers are placing GPS chips in children’s shoes. Positioning data can also be an unobtrusive tag of an object, such as an endangered tree. Discovery of new uses and applications of space products and services shows no sign of abating.

### How Space Products and Services are Used

Starting from a strong base in the communication and media sectors, space products and services have extended their impact and now deliver value across virtually all economic areas, from transportation to healthcare to financial services. Applications range from travel planning and tourism, traveler navigation, and mobile satellite radio services, to entertainment and internet connectivity aboard cruise ships, improved telemedicine services, and resource management.

The combination of positioning services with other technologies is opening new horizons in space products and services.



The Garmin nüvi® personal navigation device uses speech recognition for input. Many handheld devices are evolving to perform more than one task. The Garmin unit is a GPS device and also an MP3 player, picture viewer, alarm clock, and can receive real-time traffic alerts, among other tasks. *Image Credit: Garmin*

RTK AutoSteer technology can be mounted on most standard farm equipment to deliver accurate steering of tractors to within one inch. This tractor is shown with a roof-mounted GPS antenna and a touchscreen control for the GPS guidance system inside. In 2006, the Novariant technology was inducted by the Space Foundation into the Space Technology Hall of Fame®. *Image Credit: Novariant*



For example, heart rate monitors designed for cyclists and runners have been combined with positioning equipment to create route maps correlated to speed and heart rate. Similarly, novel vehicle tracking devices allow users to access information on speed, location and use of safety equipment in real-time over the Internet.

### ■ 3.0 | Infrastructure

This economic activity would be impossible without a strong infrastructure to support it. The *Infrastructure* section of *The Space Report 2008* explores the manufacture and deployment of launch vehicles, satellites, in-orbit platforms, probes, and planetary surface systems. Along with these systems that actually travel into space, the report describes developments in ground equipment, launch sites and space-related facilities, and supporting processes such as space insurance, institutional investment, and venture capital.

Driving the growth in global positioning system products and services, the U.S. Navigation Signal Timing and Ranging Global Positioning System (NAVSTAR GPS or GPS) continues to be the most popular and only fully operational navigation constellation, consisting of 28 active satellites in six medium Earth orbit planes. The GPS signal is available without cost to users around the world. Russia has announced plans to modernize its Global Navigation Satellite System (GLONASS) to full operational capacity of 24 active satellites by late 2009; several of these satellites were launched in 2007.

The return to flight of the Space Shuttle in 2005 and 2006 signaled the National Aeronautics and Space Administration's (NASA) commitment to completion of the International Space Station, the flagship of global cooperation in space. The ISS depends on the resources of 16 nations: the United States, Canada, Japan, Russia, Brazil, and 11 of the European Space Agency's member states.

All but one of the remaining planned shuttle flights, through 2010, will be used to complete assembly of the station. In 2006 and 2007, six space shuttle missions were devoted to installing components on the ISS. National space agencies in China and Europe are developing plans for lunar missions in the near term. The means to reach space expanded in 2006 and 2007 with the opening of several non-federally funded spaceports, including the Oklahoma Spaceport and Blue Origin's launch site in West Texas built by Amazon.com founder, Jeff Bezos.

### ■ 4.0 | Impacts and Workforce

Space exploration and the enhancement of life on Earth brought by space products and services ultimately depend on the skilled men and women who design and operate spacecraft and invent new ways to exploit space technology. These engineers, scientists, tradespeople, and



The African Wildlife Foundation uses collars with GPS and radio signals to track the movements of lions at Tarangire National Park in Tanzania, Eastern Africa, as part of the Maasai Steppe Lion Research Project. Image Credit: Nina Marie Mosser



Astronaut Peggy Whitson, Expedition 16 commander, continues the construction of the International Space Station. All but one of the remaining shuttle flights will be used to complete assembly of the station. Image Credit: NASA

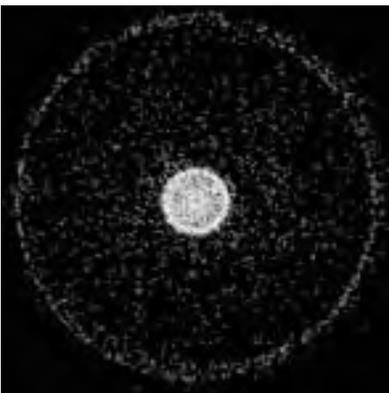
craft specialists drive the industry. In the United States, the skills of these workers and the economic growth they generate translate into wage levels far above the national average. As a result, geographical areas where the space industry is concentrated experience a significant positive economic impact.

Specific studies focusing on regional economic effects of space activity and instances of spinoffs have documented evidence of both direct and indirect economic benefit. For example, a NASA Kennedy Space Center report estimated that the Florida economy gained \$1.68 billion in fiscal year 2006 from space operations and research. Job growth in the U.S. space industry exceeded job growth in the private sector overall at pay levels roughly twice the U.S. national average, accounting for 266,700 jobs. *The Space Report 2008* provides, for the first time, details of the impact of space-related employment in state and metropolitan areas. Direct and indirect economic benefits from space industry activity contribute substantially to regional economies in Florida, Texas, Colorado, the Washington, D.C. metro area, Southern California, and elsewhere.



NASA's Crawler-Transporters are the largest tracked vehicles in existence and have been moving spacecraft at Kennedy Space Center in Florida since the Apollo era. Image Credit: NASA

These computer generated images show debris in orbit around the Earth. Top: Debris from the Chinese anti-satellite weapons test. Bottom: From a vantage point above the North Pole, this image shows objects in low Earth orbit and in the geosynchronous region. Image Credit: NASA



Another important impact of space activity is spinoffs, or technology transfer — the application of technologies and knowledge generated in space activities to other areas of the economy. Technology developed for space travel is finding its way into “smart” garments for use on Earth that can deliver music, adjust to a wearer’s body temperature, and protect against extremes of heat and cold. Space technology is appearing in such products as air bag sensors, an ingestible thermometer pill, and fire-resistant material for steel girders.

A steady supply of people with the requisite skills and education to thrive in and drive the space industry cannot be taken for granted. Demand for highly skilled workers continues, pressing the U.S. education system to produce scientists, engineers, and other specialists in order to remain competitive in a world economy that increasingly demands these talents.

## ■ 5.0 | Outlook

Provided that the space industry can continue to cultivate and recruit a skilled work force, continued growth can be expected in the economic benefits on Earth that flow from space. The past year saw rapid change in civil, national security, and commercial space driven by vastly expanding capabilities in space technologies.

Demographic change, particularly in Europe, the United States, Japan, and Russia portends problems stemming from the aging of a workforce whose skills will not be easily replaced. Nations with large populations of young people, such as China and India, that emphasize the education of scientists and engineers may have an advantage in the competition for talent. This creates opportunities for those nations to become leaders in developing space technology.

Along with the competition for talented workers comes continued competition in the use of space for national security purposes. Current programs suggest that military activity will be limited to using space assets for communication, observation, and other non-aggressive activity. China's use of a ground-launched missile to destroy an aging satellite, however, signals the possibility that new weapons technologies and strategies may be at play. The event evoked great concern over the potential threat to the long-standing international principle of the peaceful use of space.

Government space activity, while growing at a more gradual pace than commercial space activity, is no longer limited to programs run by a few superpowers. This trend is likely to continue with the increased participation in space activities by a growing number of nations. The exploration of space by humans and robots in expeditions to the Moon and beyond can be expected to expand. Access to space is available to anyone or any nation that can purchase a launch from a number of different providers around the world. No nation or group of nations controls access to space, as the United States and Soviet Union did during most of the Cold War era. This fundamental shift not only has an impact on defense and security issues, it also adds new elements of uncertainty, while creating opportunity for private space activity.

The combined public and private investment in space research, development, and commercial production has increased steadily. The shift from government being the primary source of funds for space research toward private investment has become pronounced over the past decade. If current trends continue, the commercial space sector will continue to grow in comparison to government space exploration and operations and potentially become the most important driver of overall space activities.



Two space operators provide space-based theater ballistic warning to U.S. forces in the Southwest Asia theater from the Combat Operations Space Cell inside the Combined Air Operations Center. They also run Global Positioning Satellite predictions to ensure GPS accuracy and support combat search and rescue missions when necessary via space support. Image Credit: Master Sgt. Scott Wagers/U.S. Air Force

## Methodology

*The Space Report 2008* was compiled from open-source information as well as interviews and correspondence with authoritative sources fully cited in end notes and text references. Information from interviews and correspondence is also attributed by name and date. The quantitative information included in *The Space Report 2008* comes from multiple sources, reflecting the best information available at the time of publication. While thorough, this compilation does not present comprehensive data for all space activities. For example, sales estimates for satellite imagery were not complete across the government and private remote sensing sector, and current estimates of internal research and development (IR&D) expenditures were not available. Small revenue streams from new services, such as Bigelow Aerospace's "Fly Your Stuff," are mentioned but not tabulated. In addition, an estimate for total revenues from space-focused market analysis, finance firms, and other supporting industries are missing. Budgets for small national space programs are not available for every country and, in some cases, data on additional funding outside major national space programs was not publicly available. Future editions of *The Space Report* will refine data collection methodologies and attempt to close these gaps.

Since many of the quantitative estimates included come from different sources relying on different methodologies, there is no guarantee of consistency or compatibility from one estimate to another. Where the information is available, we have described methodologies and potential conflicts, double-counting, or missing data. Whenever possible we try to minimize these conflicts and avoid double counting in the aggregate estimate of global economic space activity. When possible, we have separated revenues for manufacturing infrastructure hardware, associated institutional infrastructure, end-user products, end-user services, and government budgets.

Vertical integration in the space industry can create challenges in quantifying economic activity. The line between launch vehicle manufacturing and launch services is not always clear. Prime contractors differ in the degree to which they report subcontractor activity. Estimates of space infrastructure manufacturing revenue may overstate the value of prime contracts (the end of the manufacturing value chain) and understate the value of total space-specific manufacturing activity (the total of all steps in the manufacturing value chain).



Approximately 650 light-years away from Earth, the Helix Nebula is one of the closest planetary nebulae. This visible light image is a composite of Hubble Space Telescope and ground-based images. Image Credit: NASA, NOAO, ESA, the Hubble Helix Nebula Team, M. Meixner (STScI), and T.A. Rector

We have defined space products and services as those directly enabled by space infrastructure. However, new products and services are increasingly integrated, making it difficult to quantify the space component. To be consistent, we include the total revenue from the sale of a product or service with an end use that directly enables or relies on a space asset. For highly integrated products and services, we use this guideline to assess whether they are primarily space related.

For example, DTH satellite television is primarily space related while GPS enabled cell phones are marginally space related. In the first case, all revenue is considered part of the global space activity total, including content or other related elements. In the latter case, revenue is only included for the space related component, for instance the sale of GPS chipsets for mobile phones.

We have made a concerted effort to separate government budgets and commercial revenue. Since government space spending directly funds commercial contractors, budgets and revenues are not additive. Wherever possible, government funding was separated from reported commercial revenues to avoid double counting, such as in satellite manufacturing. However, some government expenditures are not fully accounted for, as in the case of satellite transponder leasing.

We have clearly identified what is included, what is not included or not known in the text describing these estimates. Whenever possible, we include similar sources from previous years to maintain consistency in our methodology. Every effort is made to ensure clarity for the reader and constructive feedback is encouraged from users of this product on methods to improve data or our methodology.