The Space Economy at a Glance 2014

Highlights

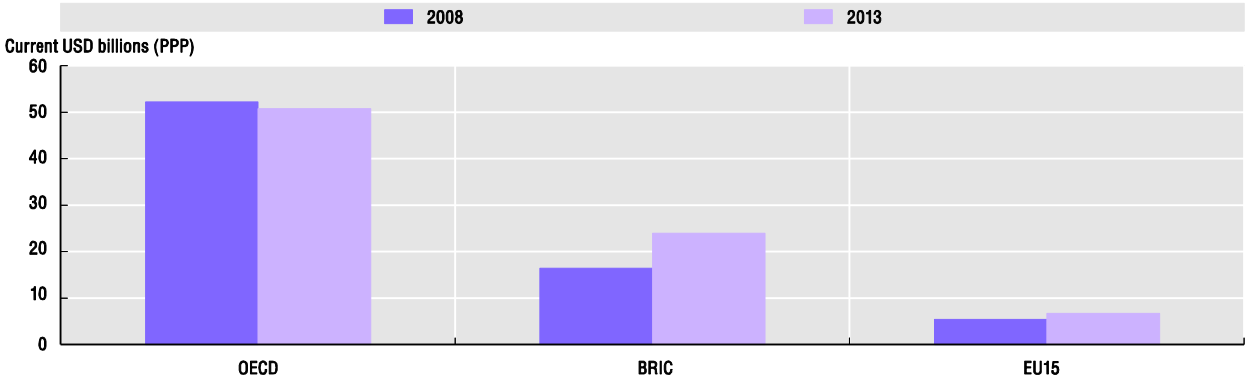
Straddling the defence and aerospace industries, the space sector has for decades been a relatively discrete sector, developed to serve strategic objectives in many OECD and non-OECD economies and contributing to advances in science and space exploration. The space sector, like many other high-tech sensitive domains, is now attracting much more attention around the world, as governments and private investors seek new sources of economic growth and innovation. The Space Economy at a Glance provides data on the space industry and key findings on the space sector's global value chains. It also highlights innovation dynamics that may revolutionise the sector and emerging policy issues.

The space sector in 2014

The acquisition and development of space capabilities remains a highly attractive strategic goal in 2014, and the number of countries and companies investing in space systems and their downstream applications continues to grow.

Despite the economic crisis, institutional funding remained stable in 2013 on a global scale, with increased budgets in several OECD countries and emerging economies. Space often has a reputation for being expensive, but national investments represent only a very small percentage relative to GDP in all G20 countries. In the United States, the largest programme in the world, space represents less than 0.3% of GDP and in France, less than 0.1% of GDP. The United States, China, India and the Russian Federation are among the top-four investors on space in 2013 using purchasing power parities or PPPs. The United States has the highest space budget per capita, representing some USD 123 PPP per habitant, followed by the Russian Federation, France, Luxembourg, Japan, Belgium, Germany and Italy. Although OECD countries accounted for the largest space budgets globally in 2013 (USD 50.8 billion, using PPPs), an increasing part of global space activities takes place outside of the OECD, particularly in Brazil, the Russian Federation, India and China (with estimates of around USD 24 billion PPPs).

OECD, BRIC and EU15 space budgets



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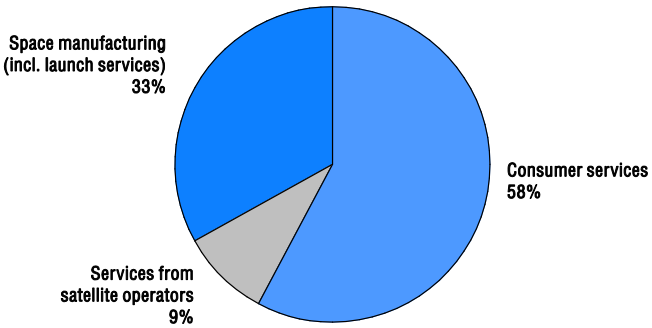
As another evidence of rising international diversity, some 72 different national administrations indicated by late 2013 their intent to launch satellite networks to the International Telecommunication Union (ITU). The ITU co-ordinates with national administrations the use of radio spectrum internationally and assignment of satellite orbits to avoid interferences. France and the United States have the largest shares of total ongoing ITU requests (14.5% and 13.4%), although many economies in Asia and the Middle East have also recently submitted new satellite networks projects planned to be brought into use over the next four to five years (i.e. China, Japan, Israel, Qatar, Saudi Arabia, United Arab Emirates).

In all countries, the role of governments remains essential as a source of initial funding for public R&D, as well as a major anchor customer for many space products and services. The global space sector is a high-technology niche with a complex ecosystem, which employed at least 900 000 persons around the world in 2013, including public administrations (space agencies, space departments in civil and defence-related organisations), the space manufacturing industry (building rockets, satellites, ground systems), direct suppliers to this industry (equipment, components), and the wider space services sector (mainly commercial satellite telecommunications). But these estimates do not take into account many other actors, including universities and research institutions, which also play a key role in R&D, as receivers of public contracts and initiators of much of the space sector's innovation.

Main segments of the global space economy

Revenues from commercial actors, USD 256.2 billion globally in 2013



The "space economy", as defined by the OECD Space Forum, comprises the space industry's core activities in space manufacturing and in satellite operations, plus other consumer activities that have been derived over the years from governmental research and development. In 2013, commercial revenues generated by the space economy amounted to some USD 256.2 billion globally (i.e. including estimates from actors in Europe, North America, South America, Asia, the Middle East).

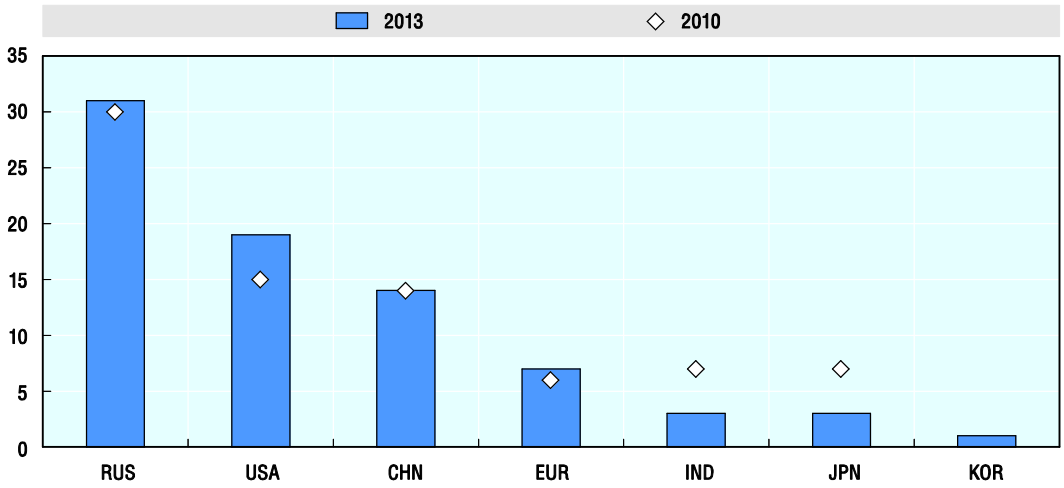
The space manufacturing supply chain (from assembly of complete spacecraft systems to components) represents conservatively some USD 85 billion globally. This number is probably relatively underestimated since there are institutional programmes in many countries that are the sources of unreported contracts to national space industries (e.g. defence activities). This important segment is often characterised by largely captive markets, since much of the demand for institutional satellites, launchers and ground segment is often directed at national industries. However, more actors than ever before are involved in supplying space products.

The second segment includes services from satellite operators (owners and operators of satellites) generated some USD 21.6 billion in revenues (i.e. satellite telecommunications operators: fixed and mobile satellite services, satellite radio services, and commercial remote sensing operators). These are important actors, as they have to service governmental and commercial customers outside the space sector (e.g. providing bandwidth, imagery), so they tend to push space manufacturing suppliers for more innovation to respond to market needs at lower cost (e.g. development of broadband via satellite).

Finally, the consumer services segment includes actors, often outside the traditional space community, which rely on some satellite capacity for part of their revenues. Although their share is the most difficult to assess, these downstream activities are an integral part of the space economy, as valuable satellite signals or data contribute to new commercial equipment and services. They include direct-to-home satellite television services providers, satnav consumer equipment and value-added services, and very-small apertures terminals providers (e.g. data handling, banking), with revenues estimated at some USD 149.6 billion.

All measurements are of course beset with definitional and methodological issues, and so estimates may vary. For example, using a slightly different scope and more limited national data, the space economy was valued in 2011 at USD 150-165 billion.

International distribution of successful space launches in 2010 and 2013



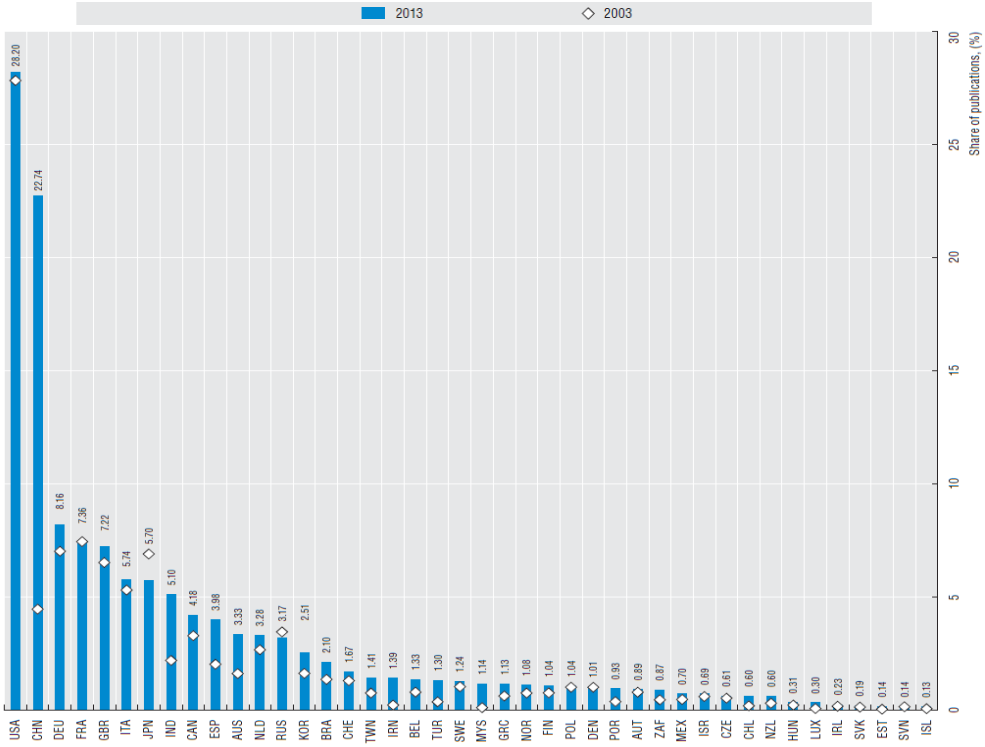
Source: Adapted from the US Federal Aviation Authority, 2014.

Globalisation of the space sector is accelerating

Even if the space sector remains heavily influenced and shaped by strategic and security considerations, globalisation is affecting the space economy at different levels. In the 1980s, only a handful of countries had the capacity to build and launch a satellite. Many more countries and corporate players across a wide range of industrial sectors are now engaged in space related activities, a trend that is expected to strengthen in the future.

Scientific production in satellite technologies per country

Share of publications per country, 2003 and 2013



During the cold war, major scientific and engineering breakthroughs took place in different parts of the world, often in isolation, as military research and development and industrial secrecy forced economies to preserve their own technological advances. One of the first emblematic joint space missions took place in 1975, when an American Apollo spacecraft, carrying a crew of three, docked in orbit for the first time with a Russian Soyuz spacecraft with its crew of two. In addition to the political significance of the event, it was a major engineering accomplishment as at the time both the US and the Russian industrial chains relied entirely on domestic hardware and national standards. Bilateral working groups were set up for the first time to develop compatible rendezvous and docking systems in orbit, which are still in use today.

As international conferences of scientists have prospered since 1991, allowing researchers to collaborate on and disseminate scientific advances, knowledge flows and dual-use technological transfers have also increased, particularly from OECD economies and the Russian Federation to other parts of the world.

While the mode of interaction between space actors may vary (e.g. in-kind co-operation among space agencies, contracting out to foreign suppliers, industrial offset programmes), the trend towards globalisation is having an impact right across the space economy – from R&D and design, to manufacturing and services. Many space technologies are dual use, i.e. employed for both civilian and military programmes, which tends to constrain international trade in space products. Nonetheless, as evidenced by recent OECD research on global value chains, product and service supply chains for space systems are internationalising at a rapid pace, with hubs in different parts of the world.

Top 20 regions in space-related patents

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In a 2012-13 survey of the US space industrial base, 78% of the US organisations surveyed considered they were not the sole manufacturer or distributor of a given space product, based on the total number of product areas identified. Respondents identified critical suppliers from 56 countries (DoC, 2014). The most prominent non-U.S. suppliers were located in Japan, Germany, Canada, France, and the United

Kingdom, providing materials, structures, mechanical systems, electronic equipment, and communications systems. Russian hardware is also often procured by US manufacturers, particularly propulsion systems integrated on US rockets and satellites. At the lower tiers, the global market for space-qualified components (e.g. diodes, capacitors, resistors, electric cables) has become in recent years highly competitive between American and European components manufacturers, with other actors now also exporting components, like Japan, South Korea, Turkey and Israel. As more actors seek to enter global value chains, competition on the relatively small commercial open markets for spacecraft, launchers and parts is getting stronger for incumbents. In parallel, the expansion of aerospace and electronics groups to address new national markets by creating subsidiaries, where fresh public investments in space programmes are being made, is affecting human resources.

As new opportunities arise, in the form of scientific co-operation, technological innovations, new applications, emerging markets etc., so too do new risks – the growing vulnerability of widely stretched supply chains to various kinds of disruption is just one example. Balancing these new risks and opportunities over the next few years will prove challenging for policy makers and industry players alike. To better face these trends, two avenues could be pursued by policy makers: better tracking of who is doing what, and sustaining value-creating industries.

- To better track who is doing what in the space industry, a number of initiatives can be taken by national administrations. In addition to working with industry associations, promoting and conducting regular industry surveys, other official information sources in governmental agencies could be better exploited to provide a better picture of the actors involved in space-related activities (e.g. analyzing administrative data on firms, information on contracts). This would be conducive to improving the quality of national industrial policy evaluations, with detailed information on the structure, positioning along the value chain and competitiveness of the space industry and other actors involved in the larger space economy.
- As economies get more interdependent and interconnected, all countries and all firms have the opportunity to participate and benefit from global value chains in the space sector. However, this situation puts new competitive pressures on governments to adopt reforms that enable their producers to find or to try retaining niches in which they may make the most of their capabilities. There is a need for complementary policies, such as those that boost education and skills, as well as ensuring long-term investments in national research and development capabilities, leading to future innovation.

The "democratisation" of space is gaining ground

Scientific and technological innovations are making space applications more accessible to more people. It still takes years of R&D, with sustained funding, to develop leading-edge sensors and new spacecraft, however new dynamic forces are being unleashed in the space sector, with some technological innovations coming increasingly into use (e.g. electric propulsion systems on-board large telecommunications satellites, 3-D printing used by industry and tested in orbit on the International Space Station) and others just around the corner (e.g. advances in miniaturisation making small satellites even more affordable). These new dynamics, coupled with globalisation, could increasingly impact the way space activities are conducted around the world, particularly for incumbent industrial actors.

It is now possible for universities to buy off-the-shelf technologies and equipment to build micro-satellites with ever-growing functionality. Small satellites have become in the past five years more attractive than ever, due to their lower development costs and shorter production lead times. There is still a natural trade-off to be made between a satellite's size and its functionality, i.e. the smaller a satellite is, the fewer useful instruments it can carry, and the shorter its lifetime will be since it carries less fuel. However advances in both miniaturization (e.g. increased utilisation of micro-electromechanical systems or MEMS; reduction of Attitude Determination and Control components) and improved satellite integration technologies have dramatically diminished the scope of that trade-off.

Small satellites are also becoming more affordable. Commercial off the shelf (COTS) components and consumer electronics are now commonly used to build small satellites at the lower end of the cost range. Several commercial companies fabricate structures for a large variety of small satellite missions, and it is even possible to buy online most of the components and subsystems to build a nano-satellite in-house. The main cost barrier remains the access to space, although significant progress may occur in that domain in the next decade. Cubesats, one-meter square small satellites, are particularly popular in universities, as technology demonstrators. As of spring 2014, almost a hundred universities worldwide are pursuing cubesat development and some 200 cubesats have already been launched. The first launch occurred in 2002, with more than 100 launched in 2013 alone. Twenty-six countries have developed cubesats so far, with the United States launching over half of the satellites, followed by Europe, Japan, Canada, and several South American countries.

Innovative industrial processes are promising to potentially revolutionise space manufacturing, with for example the adaptation of the automobile industry's mass production techniques to selected space systems.

Socio-economic impacts from space investments are becoming more visible

Socio-economic impacts derived from space investments are diverse. Impacts of using space applications can often be qualitative (e.g. improved decision-making based on satellite imagery) but also monetarily quantifiable in documented cases, such as cost-efficiencies derived from using satellite navigation tools. However, the flow of evidence-based information to decision makers and citizens needs to be improved.

Selected economic impacts of space applications in different sectors

	Sectors	Documented impacts of selected satellite-related applications			Illustrations
		Weather	*Navigation*	*Telecom*	
Productivity/efficiency gains	Airlines industry	Yes	Yes	Yes	Efficiency gains in the air transport sector due to better weather forecasts
	Sea shipping transit-time	Yes	Yes	Yes	Efficiency gains, as a result of better weather forecasts, and navigation (GPS, satellite-based ice charts)
	Fishing industry	Yes	Yes	Yes	Efficiency gains and improved control of resources (illegal fishing), as a result of satellite navigation usage in ships and maritime zones surveillance with satellite observations
	Energy sector	Yes	TBD	Yes	Annual gains in the energy sector , as a result of better forecasting demand for electricity (improved weather forecasts and real-time information)
Cost Avoidances	Oil pollution detection	Yes	Yes	Yes	Cost avoidances/savings in terms of detecting and managing oil incidents
	Flood prevention and management	Yes	Yes	Yes	Cost avoidances/savings in terms of anticipating and managing flood events

Efficiency and productivity gains derived from the use of space applications are becoming more visible across very diverse sectors of the economy, although experiences in estimating impacts vary across countries. From agriculture to energy, and routine surveillance, institutional actors and private companies are increasingly using satellite signals and imagery in geospatial tools. Satellites can also play a key role in providing communications infrastructure rapidly to areas lacking any ground infrastructure, contributing to link rural and isolated areas with urbanised centres.

Significant improvements have been achieved in weather forecasts over the past decade, due in part to a larger international fleet of improved meteorological satellites, bringing about substantial gains in the accuracy of forecasts of large-scale weather patterns in both hemispheres. This has directly benefited early warnings of major hydrometeorological hazards (such as cyclones, thunderstorms, heavy snowfall, floods and heat waves, to name but a few). Satellite data have also made it possible to better track extreme weather events, more cost-efficiently. When assessing the net benefits of space investments, more effort is needed internationally in building the knowledge base and devising the mechanisms for transferring know-how and experience to practitioners worldwide. This can improve the provision of evidence-based information on the benefits and limitations of space applications, while at the same time reducing the risk of "reinventing the wheel".

Another area of impact of products derived from space research can be found outside the space sector. Space technologies are usually developed to respond to specific needs, but once they are created, they may have multiple uses. Over the years, space agencies have been facilitating the exploitation of space technologies to non-space applications. As of 2012, based on its database, NASA has documented nearly 1 800 spin-off technologies to sectors as varied as health and medicine, transportation, manufacturing practices and materials, or computer technologies (NASA, 2014). In Europe, documented applications of European space technology transfers to diverse sectors include for instance air purification systems in hospital intensive care wards, radar surveying of tunnel rock to improve the safety of miners, and enhanced materials for a wide variety of sporting products from racing yachts to running shoes (ESA, 2014).