

# 2 Progress in concepts, definitions and measurement of the space economy

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This chapter of the *Handbook* outlines key concepts and defines the space economy and other key terms used to describe and measure activities in the space economy. It also identifies different space products and services in national and international statistical frameworks to facilitate measurement.

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## Defining the “space economy”

Space applications are increasingly pervasive in many daily activities and there are a growing number of commercial activities taking place in orbit.

A decade ago, the OECD Space Forum conducted a series of expert workshops and broad consultations with diverse administrations, industry associations and small and large private sector stakeholders, in order to develop a concept of the space economy that captured the full range of space activities. Using lessons learnt from other sectors, notably the digital economy, a definition of the space economy was developed with the aim to encompass the different dimensions of programmes, services, and actors. The following working definition formed the starting point for the first *Handbook on Measuring the Space Economy* published in 2012 (OECD, 2012<sup>[1]</sup>).

*The space economy is the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space.*

*Hence, it includes all public and private actors involved in developing, providing and using space-related products and services, ranging from research and development, the manufacture and use of space infrastructure (ground stations, launch vehicles and satellites) to space-enabled applications (navigation equipment, satellite phones, meteorological services, etc.) and the scientific knowledge generated by such activities. It follows that the space economy goes well beyond the space sector itself, since it also comprises the increasingly pervasive and continually changing impacts (both quantitative and qualitative) of space-derived products, services and knowledge on economy and society (OECD, 2012<sup>[1]</sup>).*

Ever since, this OECD definition has been used extensively by the space community and public bodies, albeit with differing interpretations of which activities to include in specific segments.

Over the years, one prominent issue in measurement has concerned the inclusion of many new, mainly digital, goods and services that use products and technologies developed in the space sector as an intermediate input. An important trigger for this discussion was the growing use of embedded satellite signals (through Global Positioning System based products, for example) and data (e.g. through commercial geographic information systems) in different mass-market products and services (navigation apps in mobile devices, game apps in smartphones etc.). Direct-to-home satellite broadcasting is another example as major media players offer bundled services with cable, fibre and satellite solutions (see Box 2.1).

Two key recurring questions are:

- Should the scope of the space economy be limited to activities generating products and technologies intended to fulfil the functions of a space programme or in support of a space activity?
- Alternatively, should the definition also include industries producing digital products and services that are quite remote from traditional space activities, but which clearly rely on space capacities (satellite signals and data) to exist? In other words, should all the activities that use space services as an intermediate good be included in measurements of the space economy?

Within this context, the OECD Secretariat launched a new consultation process concerning the evolving definitions of the space sector and its derived activities. The consultation process involved more than 100 organisations from national administrations, business enterprises and industry associations. In parallel, several countries and agencies have also focused on what should be considered the space economy in their own definitions.

In 2020, the US Bureau of Economic Analysis (BEA) formulated the following definition when compiling their Space Economy Satellite Account (see the next sections for more on satellite accounts):

*“The space economy consists of space-related goods and services, both public and private. This includes goods and services that:*

- are used in space, or directly support those used in space
- require direct input from space to function, or directly support those that do
- are associated with studying space” (Highfill, Jouard and Franks, 2020<sup>[2]</sup>).

This definition enables the categorisation and identification of selected products and services that are part of the space economy. It opens up new questions for some products (e.g. there was debate with the US space industry on whether or not to include ground-based solar panels that require a space input for energy generation, i.e. the sunlight). But overall, it covers well a whole of range of space products and services.

Based on all these recent developments and the extensive international consultation process (see Chapter 1 for a recap), there was a broad consensus in favour of standardising the overarching concept of the “space economy” in order to promote a common understanding and a common vocabulary when distinguishing between different space activities. Therefore, the *Handbook* recommends taking a comprehensive approach to measurement.

The end-result of this analysis is a set of general concepts and definitions that should help stakeholders get a better sense of which activities and actors to include in their analysis of space activities including:

- two general segments of the space economy, which can be measured more or less readily in official and industry statistics, and a third one, which provides an indication of the growing space economy pervasiveness in the economy
- better defined categories of activities based on existing practices.

## General concepts: Identifying the main sectors of space applications and the three main segments of the space economy

The following sections identify the main sectors of application of space activities and the three segments of the space economy for measurement purposes. They feature activities that may be more or less challenging to measure.

### ***Main sectors of space applications***

The different uses or applications of space activities evolve constantly as space technologies become increasingly embedded in systems and services used in routine activities. Using well-recognised definitions and experiences from different countries surveying their space economy, the most common space activities are the following:

- **Satellite communications:** The development and/or use of satellites and related subsystems to send signals to Earth for the purpose of fixed or mobile telecommunications services (voice, data, Internet, and multimedia) and broadcasting (TV and radio services, video services, Internet content).
- **Positioning, navigation and timing:** The development and/or use of satellites and related subsystems for localisation, positioning and timing services. Navigation is used for air, maritime and land transport, or the localisation of individuals and vehicles. It also provides a universal referential time and location standard for a number of systems.
- **Earth observation:** The development and/or use of satellites and related subsystems to measure and monitor Earth, including its climate, environment and people.
- **Space transportation:** The development and/or use of launch vehicles and related subsystems. This includes launch services, government and commercial spaceports, space adventure rides, as well as “last mile” and logistics services for transportation between orbits, etc.

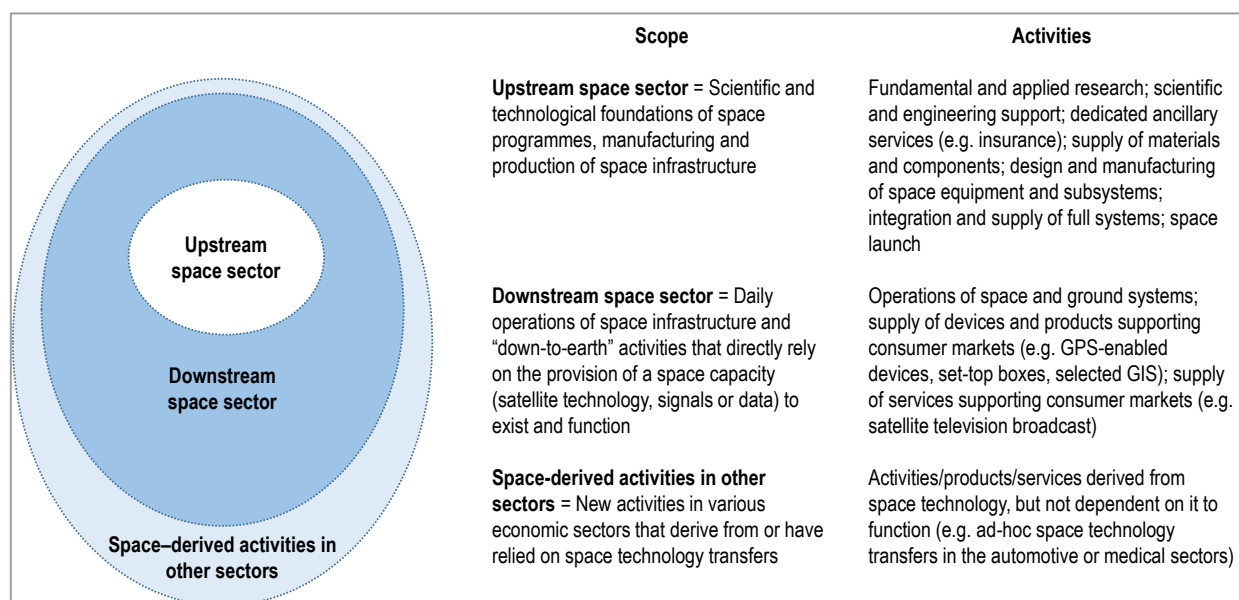
- **Space exploration:** The development and/or use of crewed and uncrewed spacecraft (including space stations, rovers and probes) to explore the universe beyond Earth's atmosphere (e.g. the Moon, other planets, asteroids). Included in this sector are the International Space Station and astronaut-related activities.
- **Science:** The category includes a range of scientific activities including space science, i.e. the various scientific fields that relate to space flight or any phenomena occurring in space or on other planets (e.g. astrophysics, planetary science, space-related life science, space debris tracking); and space-related earth science, i.e. the various science fields that use space-based observations to study the physical and chemical constitution of the Earth and its atmosphere (e.g. atmospheric science, climate research).
- **Space technologies:** The category may include specific space system technologies that are used in various space missions, such as space nuclear systems (power, propulsion), solar electric propulsion, etc.
- **Generic technologies or components that may enable space capabilities:** Some of these are not initially destined for use on a specific space system or for a specific space application but may then lead to new products and services (e.g. artificial intelligence and data analytics software). This could be the case for early-phase research, small off-the-shelf components used in various systems, or services based on integrated applications.

These are the main activities to focus on at this stage. Some organisations list “defence” as a separate application in order to distinguish between civil and military space activities. This *Handbook* does not make this distinction at the applications level but suggests the tracking of different types of procurers of space products and services including defence organisations (see Chapter 4 on surveys).

### ***The three main segments of the space economy***

The space economy concept is built upon decades of space operations via national space programmes and commercial activities and aims to improve international comparability across countries. It covers the main space activities listed in the previous section and divides the space economy loosely into three segments as shown in Figure 2.1. Using these general segments should allow for better international comparisons while also corresponding with existing data in many countries. The three segments are:

- The upstream segment representing the scientific and technological foundations of space programmes (e.g. science, R&D, manufacturing and launch): This segment is relatively easy to measure with official and industry statistics.
- The downstream segment (space infrastructure operations and “down-to-earth” products and services that directly rely on satellite data and signals to operate and function): Some, but not all, of the activities in this segment are easy to measure with official and industry statistics.
- Activities that are derived/induced from space activities but are not dependent on it to function (e.g. technology transfers from the space sector to the automotive or medical sectors): This segment is not easily or readily measurable and necessitates extra steps for measurement (more in Chapter 5). The advantage of mentioning and considering it, is that it could lead to a better understanding of the pervasiveness of a growing number of space activities in the broader economy.

**Figure 2.1. Defining the main segments of the space economy**


An increasing number of organisations are starting to use the “mid-stream” concept (between upstream and downstream) to categorise space and ground system operations and describe activities along the value chain (Australian Space Agency, 2021<sup>[3]</sup>). These crucial activities constitute the link between satellites and terrestrial infrastructures. They may be categorised in either upstream or downstream activities depending on methodological choices. Here, the *Handbook* recommends these activities be part of the downstream segment (see the section on Downstream space activities).

### **Upstream space activities**

Any space programme requires strong scientific and technological foundations ranging from basic research to full production of space and ground systems. These activities are considered the upstream segment and include the following categories:

- fundamental and applied research activities conducted at higher education institutions, public research organisations, and private and non-profit research organisations
- ancillary services such as finance, insurance and legal services and consultancies
- scientific and engineering support including the provision of research and development services, engineering services such as design and testing and similar activities
- supply of materials and components for space and ground systems, including both passive parts (cables, connectors, relays, etc.) and active parts (e.g. diodes, transistors, semiconductors)
- design and manufacture of space equipment and subsystems such as electronic and mechanic equipment and software for space and ground systems, as well as systems for spacecraft guidance, propulsion, power, communications, etc.
- integration and supply of full systems including complete satellites/orbital systems and launch vehicles as well as terrestrial systems such as control centres and telemetry, tracking and command stations.

These activities are conducted by the government sector, space business enterprises and the scientific community at large and they are essential enablers for downstream activities. Historically, upstream space activities have been the focus of space economy statistics put together by governments and industry

associations. Recent and future space activities could also be included here, e.g. space tourism, on-orbit servicing, active debris removal, on-orbit manufacturing and resource extraction.

Table 2.1 below showcases selected upstream activities and the organisations involved in the segment.

**Table 2.1. Selected activities, products and services in the upstream space segment**

Main groups of activity	Subgroups	Selected products and services	Type of organisations involved
Research, engineering and other services	Fundamental and applied research	<ul style="list-style-type: none"> <li>Fundamental and applied research</li> </ul>	Universities, public and not-for-profit research organisations
	Ancillary activities	<ul style="list-style-type: none"> <li>Insurance and legal services</li> <li>Market research</li> <li>Finance</li> </ul>	Insurance, law and research consulting firms, venture capital firms
	Scientific and engineering support	<ul style="list-style-type: none"> <li>Research and development services</li> <li>Engineering services (design, testing, etc.)</li> </ul>	Engineering firms, universities, public research organisations and agencies
Space manufacturing	Supply of materials and components	<ul style="list-style-type: none"> <li>Materials and components for both space and ground systems: Passive parts (around 70% of components in space sub-systems: Cables, connectors, relays, capacitors, transformers, RF devices, etc.) and active parts (e.g. diodes, transistors, power converters, semiconductors)</li> </ul>	Suppliers and component manufacturers. Includes both off-the-shelf and specialised suppliers
	Design and manufacturing of space equipment and subsystems	<ul style="list-style-type: none"> <li>Electronic equipment and software for space and ground systems</li> <li>Spacecraft/satellite platform structure and data handling subsystem (e.g. on-board computer, interface unit, satellite and launcher electronics)</li> <li>Guidance, navigation and control subsystems, and actuators (e.g. gyroscopes, sun and star sensors rendezvous- and docking sensor)</li> <li>Power subsystems (e.g. electrical propulsion, power processing unit, solar array systems, photo voltaic assembly)</li> <li>Communications subsystems (e.g. receivers and converters, fibre optic gyro, solid state power amplifier, microwave power module, downlink subsystem, transponders, quartz reference oscillators, antenna pointing mechanism)</li> <li>Propulsion subsystems (e.g. propellant systems, tanks, valves, electric propulsion systems)</li> <li>Other satellite payload specific subsystems</li> </ul>	Equipment and subsystem manufacturers with increasing degree of specialisation, often also catering to aeronautics and defence Many SMEs; and in recent years, an increasing number of manufacturers of very small satellite subsystems
	Integration and supply of full systems	<ul style="list-style-type: none"> <li>Complete satellite/orbital systems</li> <li>Launch vehicles (and related launch services)</li> <li>Control centres and telemetry, tracking and command stations</li> </ul>	+20 big actors worldwide, with suppliers often also catering to aeronautics and defence and governments generally forming an important part of the customer base. In recent years, increasing number of integrators of much smaller systems
Space launch and transportation		<ul style="list-style-type: none"> <li>Government and commercial spaceports</li> </ul>	+10 licenced spaceports in the United States and several projects worldwide

## Downstream space activities

Downstream space activities comprise the provision of products and services that rely on satellite signals or data, aimed at consumer and business markets. They include primarily satellite communications and precision, navigation and timing applications, but also earth observation products and services, which have greatly benefited from advances in artificial intelligence and cloud computing. As the range and diversity of commercial space applications have grown in the past five years, space downstream activities have attracted much attention, including from private investors. Downstream activities include:

- Space and ground systems operations: Satellite operations provide lease or sale of satellite capacity mainly for communications but also increasingly for earth observation. Ground systems constitute the link between satellites and terrestrial infrastructures with networks of ground stations at strategic positions (often polar or mid-latitude). Satellite operations firms may be active across the entire value chain, own their own satellites and ground stations for instance, and also provide products and services directly to customers.
- Data distribution services: A growing number of companies provide cloud computing powered platforms or services simplifying the access, use and distribution of (mainly geospatial (GIS)) products.
- Supply of devices and equipment supporting the consumer markets: Activities in this category include devices manufacturing (chipsets, terminals, global navigation satellite services (GNSS) equipment and other devices) and the development of software.
- Supply of services supporting the consumer markets: Direct-to-home (DTH) provision (television, radio, broadband – see Box 2.1); positioning, navigation and timing services provision; provision of electro-optical imagery (telemetry, tracking and command services). Current applications include cartography and mapping; logistics and distribution; sales and marketing; surveillance and security; timing and precision work; and communications.
- Supply of data added-value services: The processing of products and services from one or multiple data sources (satellite imagery/signals and in-situ observations, other sources of information) and transforming them into readily usable information. The same company may provide both raw and processed products and services. Many actors in this category do not consider themselves as space sector companies although their products depend on space signals or data.

The measurement challenge is particularly important for this segment of the space economy as the actual space-specific activities may be difficult to identify and may be easily over- or underestimated. An overview of selected downstream activities and organisations is presented in Table 2.2.

**Table 2.2. Selected activities, products and services in the downstream space segment**

Activity	Selected products and services	Examples of organisations
Operations of space and ground systems	<ul style="list-style-type: none"> <li>• Satellite operations, including lease or sale of satellite capacity (telecom: Commercial fixed- and mobile satellite services operators; earth observation operators)</li> <li>• Provision of control centres services to third parties</li> </ul>	More than 50 satellite communications operators around the world. Category also comprises ground station networks including domestic and foreign-owned ground stations as well as collaborative ground stations at polar and mid-latitude locations
Supply of devices and products supporting the consumer markets	<ul style="list-style-type: none"> <li>• Very small aperture terminal networks</li> <li>• Satnav and telecom equipment and connectivity devices</li> <li>• Chipsets</li> </ul>	Geospatial products, chipset and device manufacturers



Activity	Selected products and services	Examples of organisations
Supply of services supporting consumer markets	<ul style="list-style-type: none"> <li>• Direct-to-home (DTH) services</li> <li>• Location-based signals services</li> <li>• Cloud-based services to host and/or process geospatial data</li> <li>• Data-derived commercial services providers (sometimes called value-adders: Telematics, surveying, meteorology)</li> </ul>	Actors included in the space economy as far as a share of their activity directly relies on the provision of satellite signals or data. Providers of satellite broadcasting services tend to dominate this category in terms of revenues

### Box 2.1. Satellite broadcasting as part of the space economy's downstream activities

Direct-to-home (DTH) satellite services such as satellite television represent an important commercial activity in both OECD member countries and partner economies. Converging information technologies are increasingly combining different infrastructures to provide content to final consumers. The broadcasting operators are often large groups with many telecommunication and media activities.

Should the satellite broadcasting activities of these large media groups, typically unrelated to the space industry, be included as downstream activities of the space economy?

As compared to many other downstream space activities, demonstrating the link and reliance of these products and services on a space capacity is actually quite straightforward. Satellite television uses satellite links, although convergent technologies blur some of the packaging options (i.e. cable and fibre). Programming transmission, technology and fixed networks are recurring costs for satellite television broadcasters. As distributors of media information, most have long-term contractual commitments such as expenditures planned for several years in television rights. They also lease satellite transponder capacity. The DTH broadcasters contract out the commercial satellite operations for digital transmissions to their retail subscribers and free-to-air broadcast services.

By analysing the annual accounts of these large telecommunications groups, a formal link to a space activity may be documented transponder agreements such as operating leases and specific transponder prepayments. Although estimates can be made, it is more challenging to determine the share of revenues that are directly derived from the use of satellites. A number of consulting firms that serve telecommunication satellite operators and manufacturers provide regular market studies on existing and planned satellite transponders' usage and the market prices involved. Such studies provide a first indication of the share of revenues derived from space activities. To refine data on broadcasters, one avenue is to examine annual reports where some details are publicly available. If such details are not publicly available, dedicated surveys of DTH satellite service providers may be necessary.

Although DTH activities represent a strong case-study in how satellites benefit consumer markets, the significance of these commercial satellite broadcasting activities should not be overestimated (i.e. these activities still represent overall very small percentages of the multi-billion revenues generated by the large media and telecommunication groups). However, when relevant, the value associated with commercial satellite use should be clearly identified and included in estimates of the space economy's downstream activities.

### ***Other space-derived activities***

The third and last segment consists of broad economic activities that were developed at least partially thanks to the use of space technologies. This segment is quite distinct from the upstream space sector, as it usually involves users who may have benefited from space technology transfers to create their own new



products (Olivari, Jolly and Undseth, 2021<sup>[4]</sup>). These outcomes can be measured by specific surveys and impact assessment studies (see Chapter 5).

The automotive and medical sectors, for instance, are home to many derived products that originally benefited from initial investments in the upstream space segment. Different monitoring techniques may be applied to keeping track of these particular indirect outcomes of space research and development (some of which are also outlined in Chapter 5).

### Box 2.2. Defining a “space company”

Defining a “space company” has been a challenge for a long time. Very often business enterprises involved in the manufacturing of space products and/or in the provision of space-related services are also involved in other areas of the economy. They may derive only a part of their revenues from space activities. In other words, most business enterprises that produce upstream products and services for the space economy also produce goods and services beyond the space economy. As an illustration, it is not possible to count the total revenues of large aerospace manufacturers or media groups, as being entirely part of the space economy. To avoid overestimation, a major point is to check whether a space product or data is an integral part of the final service sold, and if so, to determine the value of the space item in the final output of the company.

In its 2013 study of almost 4 000 organisations in the US space sector, the US Department of Commerce found that some 71% of respondents were serving more than one market segment including aircraft, electronics, energy, missiles, ground vehicles, ships etc. (US Department of Commerce, 2013<sup>[5]</sup>). The rapid digitalisation of the downstream sector poses even greater challenges for the delineation between the space and non-space economies.

Much attention has been given to “new space” actors in recent years. New space actors include, generally speaking, upstream and downstream start-ups and new entrants from other areas (information and communications technologies firms including those engaged in data analytics in particular). The bulk of these new entrants may be identified through information on the recipients of government grants and services, participants in (government)-organised challenges, winners of prizes and different types of start-up support (incubators, accelerators, etc.), and following the investments of venture capital. As an illustration, SpaceX was the fourth largest NASA contractor in 2020 (by procurement awards), after Boeing, Lockheed Martin and Jacobs Technology, a technical professional services firm (NASA, 2021<sup>[6]</sup>).

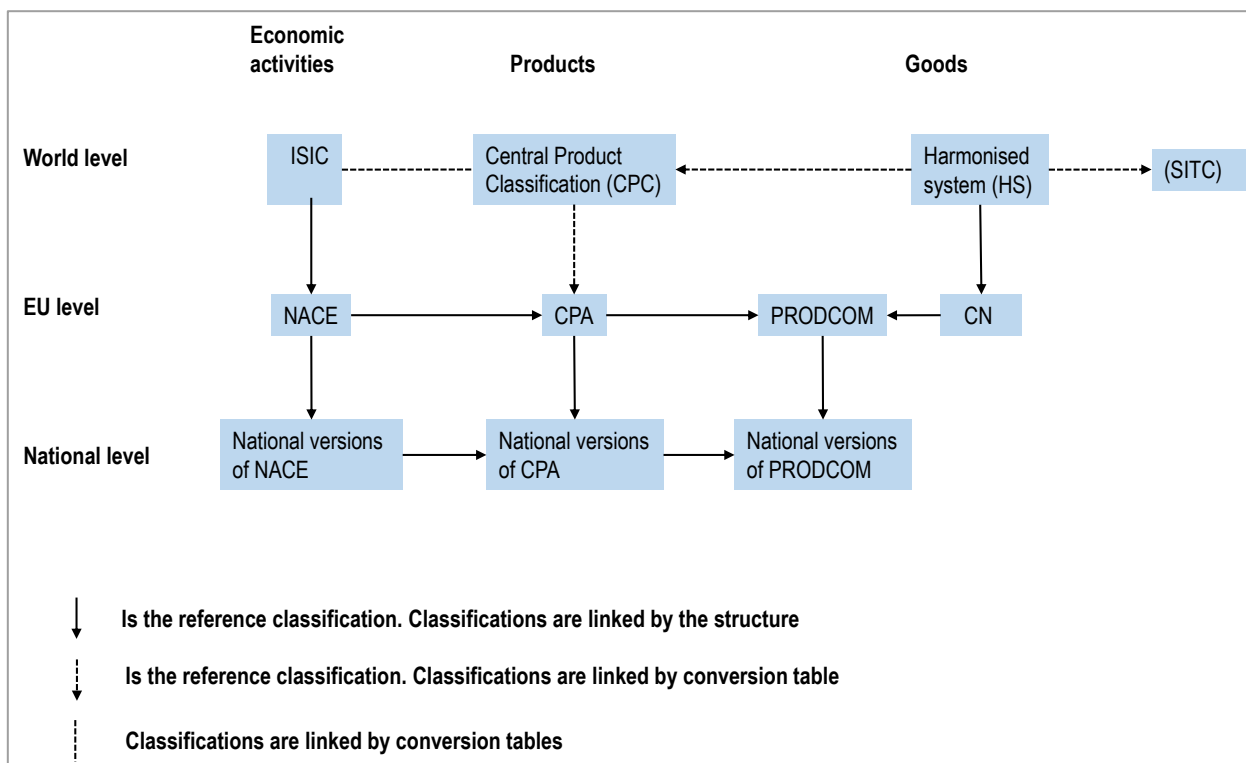
## Measurement strategies: Identifying space activities, products and services in statistical information systems

Statistical classification systems provide definitions of the categories of economic activities and other related concepts used in economic statistics. Because of the relatively small size of the space economy, as well as the highly dispersed and varied nature of space activities, the production of space-related products and services (or commodities) tend to be spread across a wide number of economic activities. This makes it challenging to identify and distinguish space activities, products and services in statistics that rely upon existing classifications. However, official statistics based on existing statistical classification systems may still be used to form a baseline and allow comparisons across the economy as shown in the next sections.

### ***International statistical classifications and their role in categorising the space economy***

Many studies of the space economy use existing statistical classification systems and relevant codes for economic activities as the starting point of their analysis. Examples of classifications include the United Nations' International Standard Industrial Classification of All Economic Activities (currently ISIC Revision 4), the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2.1), and the International Standard Classification of Occupations (ISCO-88). These are carefully coordinated with the System of National Accounts (SNA), which is the standard framework for economic accounting in OECD member countries. An overview of the links between international classifications recommended in the European System of National Accounts can be seen in Figure 2.2.

**Figure 2.2 Overview of relationships between different international and European classifications**



Source: Eurostat (2008<sup>[77]</sup>), "NACE Rev. 2: Statistical classification of economic activities in the European Community", <http://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF>.

ISIC consists of a coherent and consistent classification structure of economic activities based on a set of internationally agreed concepts, definitions, principles and classification rules. The categories of economic activity are subdivided in a hierarchical, four-level structure of mutually exclusive categories. None of these categories is fully concordant with space activities even at the most detailed level. ISIC categories that include activities considered part of both the upstream and downstream segments of the space economy include aerospace, electronics, telecommunications and even armaments since rockets are counted as weapons in many countries (e.g. missile technology). Table 2.3 contains ISIC codes for categories of economic activity that partially include space activity for high-level international comparisons.

Since the publication of the first *OECD Handbook on Measuring the Space Economy*, an updated ISIC classification has been agreed upon. The current edition of ISIC (Rev. 4) (UN Department of Economic and Social Affairs, 2008<sup>[81]</sup>) includes a new category on satellite communications. The class 6130 "Satellite telecommunications activities" comprises three space-related components:

- the use of a satellite telecommunications infrastructure for operating, maintaining or providing access to facilities for the transmission of voice, data, text, sound and video
- the use of direct-to-home satellite systems for the delivery of visual, aural or textual programming received from cable networks, local television stations or radio networks to consumers (it is detailed in the class 6130 description that the units classified here do not generally originate programming material themselves)
- the provision of Internet access by the operator of the satellite infrastructure.

ISIC Rev. 4 is considered a reference classification for most regional and national classification systems and it enables international comparisons between statistics categorised accordingly. The Statistical Classification of Economic Activities in the European Community (NACE) mostly corresponds with ISIC Rev.4 and includes more detailed categories suitable for European users of the classification at lower levels. The North American Industry Classification System (NAICS) also partially relates to ISIC Rev.4 and is almost entirely concordant up to the two-digit level of detail. There is also concordance with the Australian and New Zealand Standard Industrial Classification (ANZSIC) and other regional and national classifications.

Findings from industry surveys and studies indicate that the bulk of space activity tends to be measured under ISIC Rev.4 Section I: Information and communications (covering satellite communications) and Section C: Manufacturing (covering space manufacturing) (see Chapter 4 on industry surveys).

As of early 2022, new revision processes are underway for almost all classification systems to take into account the growing digitalisation of the economy in official statistics (i.e. ISIC, NACE, NAICS and also CPC classifications).

**Table 2.3. Selected two-digit space-related ISIC codes for international comparisons**

Examples of space activities	ISIC Rev. 4 section	ISIC Rev. 4, two-digit code	ISIC description
Fundamental and applied research	M: Professional, scientific and technical activities	72	Scientific research and development
Ancillary activities (e.g. space insurance)	K: Financial and insurance activities	65	Insurance, reinsurance and pension funding, except compulsory social security
Research and development services, engineering services (testing, design)	M: Professional, scientific and technical activities	71	Architectural and engineering activities; technical testing and analysis
Supply of components and equipment for space systems	C: Manufacturing	20	Manufacture of chemicals and chemical products
		22	Manufacture of rubber and plastics products
		25	Manufacture of fabricated metal products, except machinery and equipment
		26	Manufacture of computer, electronic and optical products
		27	Manufacture of electrical equipment
		28	Manufacture of machinery and equipment n.e.c.
Integration and supply of full space systems (e.g. launchers, satellites)		30	Manufacture of other transport equipment
Construction of space facilities (e.g. spaceports and other ground facilities, observatories)	F: Construction	42	Civil engineering
Space launch activities (freight transport and space tourism)	H: Transportation and storage	51	Air transport
		52	Warehousing and support activities for transportation

Examples of space activities	ISIC Rev. 4 section	ISIC Rev. 4, two-digit code	ISIC description
Operation of space systems	I: Information and communication	61	Telecommunications
Supply of devices and products supporting consumer markets (e.g. GNSS chipsets and devices) <sup>1</sup>	C: Manufacturing	26	Manufacture of computer, electronic and optical products
Supply of services supporting consumer markets (e.g. DTH providers, data-derived commercial services) <sup>2</sup>	I: Information and communication	60	Programming and broadcasting activities
		61	Telecommunications
		63	Information service activities
	M: Professional, scientific and technical activities	71	Architectural and engineering activities; technical testing and analysis
		74	Other professional, scientific and technical activities

1. Includes both intermediary inputs to final products such as cars (e.g. GNSS receivers) and consumer devices (GNSS devices, satellite phones). 2. Only includes activities that directly rely on the provision of a space capacity (space technology, signals or data) to exist and function.

The issue of aggregated categories can be found also in other international classifications such as the United Nation's Central Product Classification Version 2.1 (CPC Ver.2.1) and the 2017 Harmonized Commodity Description and Coding System (HS 2017) of the World Customs Organization. Table 2.4 provides the equivalences between the main classification systems.

**Table 2.4. Selected categories of space products and services in international classifications**

Space activity	CPC Ver.2.1	ISIC 4	HS 2017
Fundamental and applied research	81111 Basic research services in physical sciences	7210	-
	81114 Basic research services in engineering and technology	7210	-
	81121 Applied research services in physical sciences	7210	-
	81124 Applied research services in engineering and technology	7210	-
Ancillary services	71332 Marine, aviation, and other transport insurance services (Includes underwriting of satellite launching insurance policies)	6512	-
Scientific and engineering support	81131 Experimental development services in physical sciences	7210	-
	81134 Experimental development services in engineering and technology	7210	-
	83322 Engineering services for industrial and manufacturing projects (includes equipment for space vehicles)	7110	-
	48253 Instruments and apparatus for physical or chemical analysis, for measuring or checking viscosity, porosity, expansion, surface tension or the like, or for measuring or checking quantities of heat, sound or light	2651	9027.1, 9027.2, 9027.3, 9027.5, 9027.8
	83442 Testing and analysis services of physical properties (of materials such as metals, plastics, etc.)	7120	-
	83443 Testing and analysis services of integrated mechanical and electrical systems (of complete machinery and equipment)	7120	-
	83449 Other technical testing and analysis services (does not alter the object being tested, e.g. certification of aircraft, etc.)	7120	-
Supply of materials and components	34210 Hydrogen, nitrogen, oxygen, carbon dioxide and rare gases; inorganic oxygen compounds of non-metals n.e.c.	2011	2804.1, 2804.21, 2804.29, 2804.3, 2804.4
	89200 Moulding, pressing, stamping, extruding and similar plastic manufacturing services (includes carbon fibre)	2220	-
	89330 Metal forging, pressing, stamping, roll forming and powder metallurgy services	2591	-
	48315 Liquid crystal devices n.e.c.; lasers, except laser diodes; other optical appliances and instruments n.e.c.	2610, 2670	9013.1, 9013.2, 9013.8

Space activity	CPC Ver.2.1	ISIC 4	HS 2017
	47150 Diodes, transistors and similar semi-conductor devices; photosensitive semi-conductor devices; light emitting diodes; mounted piezo-electric crystals	2610	8541.1, 8541.21, 8541.29, 8541.3, 8541.4, 8541.5, 8541.6
	46212 Electrical apparatus for switching or protecting electrical circuits, for making connexions to or in electrical circuits, for a voltage not exceeding 1000 V	2710	8536.1, 8536.2, 8536.3, 8536.41, 8536.49, 8536.5, 85.61, 8536.69
	46320 Coaxial cable and other coaxial electric conductors	2732	8544.2
Design and manufacturing of space equipment and subsystems	48219 Other surveying, hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances	2651	9015.4, 9015.8
	4828 Parts and accessories for the goods of classes 4821 and 4823 to 4826	2651	
	48211 Direction finding compasses; other navigational instruments and appliances	2651	9014.1, 9014.2, 9014.8
	48242 Cathode-ray oscilloscopes and cathode-ray oscillographs	2651	9030.2
	48314 Binoculars, monoculars and other optical telescopes; other astronomical instruments, except instruments for radioastronomy; compound optical microscopes	2670	9005.1, 9005.8
	48244 Instruments and apparatus (except cathode-ray oscilloscopes and oscillographs) for telecommunications	2651	9030.4
	49640 Parts of aircraft and spacecraft	3030	8803
	4313 Motors and engines for aircraft and spacecraft	3030	-
Integration and supply of full systems	49630 Spacecraft and spacecraft launch vehicles	3030	8802.6
Space launch	53290 Other civil engineering works (includes. satellite launching sites)	4290	-
	65320 Space transport services of freight (i.e. launching and placing of satellites in space)	5120	-
	64250 Space transport services of passengers	5110	-
	67640 Supporting services for space transport	5223	-
	83323 Engineering services for transportation projects (includes space transportation projects)	7110	-
Satellite operations	84150 Data transmission services	6130	-
	84190 Other telecommunications services (includes Satellite tracking services)	6110, 6120, 6130, 6190	-
Downstream products and devices (and related services)	47223 Other telephone sets and apparatus for transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network) (includes: Field telephones (military))	2610, 2630	8517.18 8517.61 8517.62 8517.69
	48220 Radar apparatus, radio navigational aid apparatus and radio remote control apparatus (includes "satellite linked auto security device used to send signals via satellite to a specific vehicle to carry out electromechanical commands on that vehicle based on an encoded signal)	2651	8526.91
	54614 Residential antenna installation services (includes Installation of satellite dishes)	4321	-
	83159 Other hosting and IT infrastructure provisioning services	6311	-
Downstream services for earth observation; navigation, timing; and satellite telecommunications	83430 Weather forecasting and meteorological services (more than satellite data activities)	7490	-
	83931 Environmental consulting services		
	83421 Surface surveying services (includes collection of data by satellite)	7110	-
	83325 Engineering services for telecommunications and broadcasting projects (includes satellite radio systems and direct-broadcast satellite systems)	7110	-
	84131 Mobile voice services (includes satellite phones)	6120	-
	84140 Private network services	6130	-
	84150 Data transmission services	6130	-

Space activity	CPC Ver.2.1	ISIC 4	HS 2017
	84190 Other telecommunications services (includes satellite tracking services)	6110, 6120, 6130, 6190	-
	84221 Narrowband Internet access services, downstream speeds < 256 kbits/s (includes satellite fixed wireless Internet services)	6110	-
	84222 Broadband Internet access services, downstream speeds > 256 kbits/s (includes satellite fixed wireless Internet services)	6110	-
	84290 Other Internet telecommunications services	6130	-
	8463 Broadcasting services and multi-channel programme distribution services (includes home programme distribution services, basic and discretionary programming)	6010, 6020	-
	91134 Public administrative services related to transport and communications (includes administrative services related to satellite communications)	8413	-

Notes: The classifications codes usually include more than just space-related products and services. N.e.c. means “not elsewhere classified”.

A challenge to the use of official statistics in the measurement of the space economy is that space activities and products are not always found in the statistical classification systems used by national statistical offices. The space economy is therefore not readily visible in most of the official statistics produced. This can, however, be circumvented through additional statistical analysis.

Some national and regional classification systems provide more space-related detail than the international classifications. NAICS, for example, categorises the manufacture of space vehicles and launchers and satellite communications, but most downstream activities, such as earth observation, remain unidentified.

Below is a non-exhaustive list of four-digit ISIC codes that contain space activities together with the equivalent regional codes for North America (NAICS) and Europe (NACE). At four-digit levels, activities tend to be grouped together when they share a common process for producing products or services using similar technologies.

- Most notable is ISIC code 6130: “Satellite telecommunications activities”, which is the only ISIC four-digit code that is fully space-related.
- The other codes include 3030: “Manufacture of air and spacecraft and related machinery”, 6020: “Television programming and broadcasting activities” and finally, 2651: “Manufacture of measuring, testing, navigating and control equipment”, which covers the manufacture of chipsets and devices for global navigation satellite systems, and which accounts for a significant share of recent growth recorded in space economy estimates.

With the exception of ISIC 2651, these codes tend to represent activities producing goods and services used in final demand (i.e. the list does not include products and services consumed as inputs in the production of others, so called intermediate consumption) (United Nations Statistical Commission, 2009<sup>[9]</sup>).

In some cases, national/regional classifications provide more detailed categories for certain space activities. For example, NACE 51.22: “Space transport” provides more detail than ISIC 5120: “Freight transport”, while NAICS 336414: “Guided missile and space vehicle manufacturing” provides more detail than ISIC 3030: “Manufacture of air and spacecraft and related machinery”.

Despite their lack of space-related detail, existing statistical classification systems remain an important starting point for economic analysis of the space economy and for targeted surveys of organisations operating in the space economy. Many companies developing downstream space applications are for instance registered as data-processing companies under the ISIC four-digit code 6311: “Data processing, hosting and related activities”. In turn, targeted surveys can be used to collect basic information on the share of space activities in total activities of individual organisations, which subsequently can be linked to microdata that are already available in statistical offices for the production of official statistics. This provides

the opportunity to generate statistics at more aggregated levels. This method has recently been applied in a study on the space economy in the Netherlands (Dialogic, 2020<sub>[10]</sub>).

**Table 2.5. Selected four-digit ISIC codes for space activities and their NAICS and NACE equivalents**

ISIC Rev. 4, four-digit code	ISIC description	Full/partial coverage	Space activities	Selected products and services	Equivalent regional codes	
					NAICS (North America)	NACE (Europe)
6130	Satellite telecommunications activities	Full	Operation of space and ground systems	Satellite operations	517410 <sup>1</sup>	61.30 <sup>1</sup>
6020	Television programming and broadcasting activities	Partial	Supply of services supporting consumer markets	Direct-to-home satellite broadcasting	517311	60.20
3030	Manufacture of air and spacecraft and related machinery	Partial	Integration and supply of full space systems	Satellites, launchers	336414 <sup>2</sup> 336415 <sup>2</sup> 336419 <sup>2</sup>	30.30
2651	Manufacture of measuring, testing, navigating and control equipment	Partial	Supply of devices and products supporting consumer markets	GNSS chipsets, GNSS consumer devices	334511	26.51
5120	Freight air transport	Partial	Space launch activities	Space launch	481212	51.22 <sup>1</sup>

1. Full coverage, 2. Includes both space and guided missile manufacturing.

### ***A step further: Building a “satellite account” for space activity***

The previous sections have shown that space activities are not readily visible in official statistics. Once the relevant categories that contain space activity in official statistics have been identified, the share of each of these activities and products that is attributable to the space economy can be estimated. This is where the national accounts framework can assist.

The system of national accounts aims to measure every economic activity, even if the fine details may not be readily visible. The relationship between activities and products is made explicit through “supply and use” tables (SUTs). SUTs are produced by national statistical offices and offer a comprehensive picture of the inner workings of a national economy. SUTs record how the supply of different kinds of products and services originate from domestic industries and imports and how the use of these products and services is split between various intermediate or final uses (including exports).

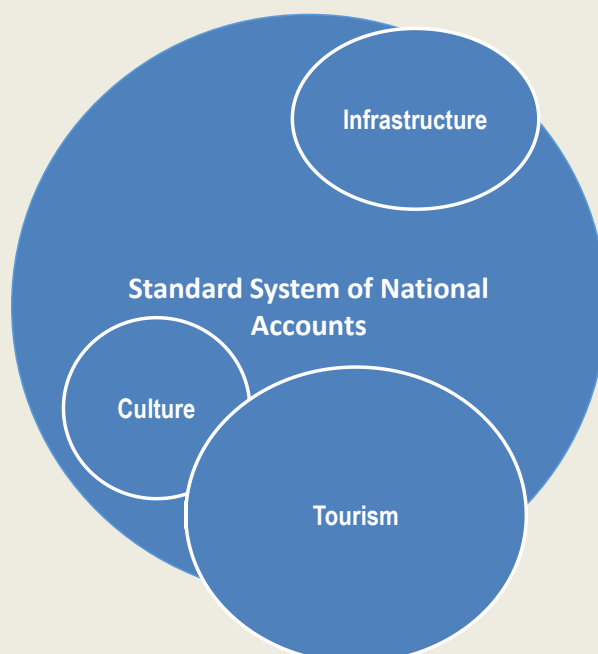
The most comprehensive way to benefit from the national accounting system is through the development of a “satellite account” for space economic activities. Satellite accounts are linked to the core national accounts but provide a more detailed description of a specific economic function or theme (e.g. environment, tourism, health, ocean economy, transport) (van de Ven, 2021<sub>[11]</sub>). Their link to the traditional system of national accounts makes it possible to compare the contribution of otherwise invisible areas to the economy as a whole (see Box 2.3).



### Box 2.3. What is a satellite account?

A satellite account can be used to unearth fields or aspects of behaviour that are fully or partially hidden in the central national accounting framework. Tourism is a typical example. Many aspects of tourism are covered in detailed classifications of activities, products and purposes, but rarely appear separately with distinct classification codes. Instead of overburdening the central framework with too many subdivisions and detail, the System of National Accounts recommends the creation of satellite accounts that are consistent with, but not fully integrated, in the central framework (van de Ven, 2021<sup>[11]</sup>).

Figure 2.3. Standard System of National Accounts and thematic satellite accounts



Source: Statistics Canada (2019<sup>[12]</sup>), "In-depth review of satellite accounting", <https://www.unece.org/stats/ces/in-depth-reviews/satellite-accounting.html>.

Satellite accounts can provide more detail, rearrange concepts from the central statistical framework and provide supplementary information on specific domains of economic activities. The main motivation is to understand the structure and/or economic performance of an activity and/or sector. The most common satellite accounts cover tourism, environmental-economic linkages and health. Accounts have also been created for education and training, transport, aviation, and the non-profit sector. In terms of complexity, they can range from simple tables to an extended set of accounts. Data are often compiled less frequently and regularly than for standard national accounts.

Sources: Van de Ven (2021<sup>[11]</sup>), "Developing thematic satellite accounts", <https://dx.doi.org/10.1787/b833cbfa-en>; United Nations Statistical Commission (2009<sup>[9]</sup>), *System of National Accounts*, <https://unstats.un.org/unsd/nationalaccount/docs/sna2008.pdf>; and Statistics Canada (2019<sup>[12]</sup>), "In-depth review of satellite accounting", <https://www.unece.org/stats/ces/in-depth-reviews/satellite-accounting.html>.

In the United States, the Bureau of Economic Analysis has led an extensive project to measure the US space economy and its contribution to the national economy through two editions of a satellite account (BEA, 2020<sup>[13]</sup>). In addition to estimating the contribution of the space economy to the national gross domestic product (GDP), the US Space Economy Satellite Account (SESA) provides data on gross output,

compensation, and employment in space industries (Highfill, Jouard and Franks, 2020<sup>[2]</sup>). The statistics produced through the account are consistent with the BEA's core economic measures and can be used to compare the space sector to other US industries and the economy overall. Building the SESA account included isolating spending on space production by rearranging the BEA's existing SUTs. The process involved the following elements:

- Relevant products and services ("commodities") were identified within BEA SUTs (Table 2.6). BEA consulted extensively with other public organisations (including the OECD) and industry experts in order to select the commodities measured (BEA, 2020<sup>[13]</sup>). Some 200 commodity codes and 28 NAICS regional industrial classification codes with space-related content have been identified. They are listed for information in Annex 2.A.
- As most commodity categories include both space and non-space components, external data sources, mainly information on space-related revenue or spending, were used to estimate the share of each commodity that could be assigned to the space economy in the SUT.
- Finally, BEA SUTs were used to determine total economic activity by industry.

**Table 2.6. Industries and commodities included in the US space economy estimates with principal data sources**

NAICS codes	Primary industries	Brief description of commodities	Principal data sources
51	Information	Telecommunications, broadcasting, software	Bureau of Labor Statistics (BLS) Occupational Employment Survey (OES); Federal Communications Commission "Internet Access Services" reports; Securities and Exchange Commission 10-K filings; Bureau of Economic Analysis supply-use tables
31-33, 42	Manufacturing, retail trade, and wholesale trade	Space vehicles; space weapon systems; satellites; ground equipment; search, detection, navigation, and guidance systems (GPS/PNT equipment)	Economic Census product line data; BEA supply-use tables
90	Government	Military, civilian, federally funded research and development centres	Public budget documents; National Science Foundation (NSF) Survey of Federal Funds for Research and Development; BEA supply-use tables
54	Professional and business services	Research and development; engineering and technical services; computer systems design; geophysical surveying and mapping services	BLS OES; NSF Survey of Federal Funds for Research and Development; NSF Business Enterprise Research and Development Survey; BEA supply-use tables
23	Construction	Space facilities, observatories, planetariums	Census Value of Construction Put in Place; BEA supply-use tables
	Other various service industries	Launch services, insurance, education, observatories, planetariums	Federal Aviation Administration "Annual Compendium of Commercial Space Transportation"; MITRE launch demand model; National Center for Education Statistics Integrated Post-Secondary Education Data System; public documents; BEA supply-use tables

Note: The table generally only includes final demand commodities, because intermediate demand commodities will be accounted for when using supply-use tables. However, for some commodities, only the value of the intermediate input has been included, and not the final demand commodity (e.g. GPS receivers for mobile phones and cars).

Source: Adapted from Highfill et al. (2020<sup>[2]</sup>), "Preliminary estimates of the U.S. space economy, 2012–2018", <https://apps.bea.gov/scb/2020/12-december/1220-space-economy.htm>.

Estimates for 2019 show that the US space economy accounted for USD 194.6 billion of gross output, contributed 0.6 percent (USD 120.3 billion) to current-dollar GDP and supported more than 356 000 private sector jobs (Highfill, Jouard and Franks, 2022<sup>[14]</sup>). Gross outputs by industry are summarised in Table 2.7.

Table 2.7. US space economy gross output by industry

Estimates in USD million (current)

Industry activities	2019
<b>Space economy<sup>1</sup></b>	<b>194 596</b>
Agriculture, forestry, fishing, hunting, mining, and utilities	7
Utilities	2
Construction	980
Manufacturing	51 158
Of which:	
Computer and electronic products <sup>2</sup>	30 030
Other transportation equipment <sup>3</sup>	18 224
Wholesale trade	31 587
Retail trade	2 280
Transportation and warehousing	1 329
Information	59 704
Of which:	
Wired telecommunications carriers <sup>4</sup>	38 284
Satellite telecommunications	6 461
Finance, insurance, real estate, rental, and leasing	349
Professional and business services	6 370
Educational services	2 701
Health care and social assistance	87
Arts, entertainment, recreation, accommodation, food services and other services	140
Other services, except government	8
Government <sup>5</sup>	37 894
Federal	34 771
State and local	3 124
Private industries	
<b>Space economy excluding satellite television, satellite radio, and educational services<sup>6</sup></b>	<b>148 683</b>

1. According to the BEA definition, the space economy consists of space-related products and services, both public and private. This includes goods and services that are used in space, or directly support those used in space, require direct input from space to function or directly support those that do, and/or are associated with studying space. 2. Includes manufacturing of satellites; ground equipment; search, detection, navigation, and guidance systems (GPS/PNT equipment). 3. Includes manufacturing of space vehicles and space weapons systems (intercontinental ballistic missiles). 4. Includes direct-to-home satellite television services. 5. Includes spending on personnel, operations, and maintenance. Government spending on private-sector investment (structures, equipment, intellectual property) is included within the individual industries. 6. This value represents a narrower interpretation of the "Space Economy" definition. These commodities are primarily produced by the Information and Educational services industries.

Source: Highfill et al. (2022<sup>[14]</sup>), "Updated and revised estimates of the US space economy, 2012–2019", <https://www.bea.gov/system/files/2022-01/Space-Economy-2012-2019.pdf>.

The US satellite account represents a detailed estimation of the size of the space economy and is the first such account constructed in the world. Since its publication, a number of countries and organisations have started to explore the satellite accounting approach in coordination with national and regional statistical offices.

As an illustration, the French space agency (CNES) has recently begun a partnership with the French National Institute of Statistics and Economic Studies (INSEE) to develop a new strategy for measuring the space economy using a satellite account approach. Although the INSEE has led surveys on the aeronautics and space sector for decades, policy demand for detailed data on the French space economy is increasing (INSEE, 2021<sup>[15]</sup>). The space economy is experiencing rapid changes, and it is of growing

strategic importance in French and European autonomy. It is also, like aeronautics, included into a series of large-scale governmental recovery plans following the COVID-19 crisis. The CNES and the INSEE will start in 2022 by targeting the upstream segment, but the goal is to extend the effort and include the downstream segment in the near future (Lafaye, 2021<sup>[16]</sup>). As another example, the European Space Agency has started co-operating with Eurostat to explore the possible development of a European-wide space economy satellite account, with a first workshop held in March 2022.

## Key take-aways to support space economy measurement strategies

The preceding sections have illustrated concepts and definitions for space activities and outlined some of the ways that official statistics can be used in the measurement of the space economy. There are several significant challenges involved in this type of measurement.

With some minor exceptions (e.g. ISIC code 6130: “Satellite operations”), existing statistical classification systems do not define space activities in isolation to all other related activities. As noted in the previous *Handbook*, changing classifications by creating codes for specific space activities is a possibility, as the ISIC classification, for instance, is revised at regular intervals (OECD, 2012<sup>[11]</sup>). It is, however, a long process necessitating co-operation and support from national statistical agencies and will not guarantee that statistics will be produced at the required level of detail.

**Targeted surveys and impact studies based on the results are likely to remain the most effective approach for analysing the space economy for most countries, as a first step:** Industry surveys can provide very useful data points for developing potential future satellite accounts. Without the type of information collected in industry surveys, national statistical offices are unlikely to be able to produce an eventual satellite account. Chapter 3 provides more information on the cast of actors in the space economy, while Chapter 4 provides lessons learnt from countries and well-established industry associations on pursuing survey-based measurement of the space economy.

**Space and statistical agencies are encouraged to be innovative in their use of different official data sources:** Combining more granular data from administrative records with official data and tools emanating from the system of national accounts is likely to provide important results to policy makers as the US Space Satellite Account demonstrates well. Projects focused on identifying the contribution of space activities to national economies through national accounting frameworks can provide new and important information on the role played by the space economy in the wider economy. However, this type of study requires the active involvement of national statistical agencies with national space communities, and sustained funding.

Providing support for data collection and analysis represents the key focus in the following chapters of the *Handbook*.

## Annex 2.A. 200 Commodity codes used for the US Space Economy Satellite Account

When launching a satellite account, a list of adequate commodities needs to be identified to build up statistical tables (Highfill, Jouard and Franks, 2020<sup>[2]</sup>). As part of the US Space Economy Satellite Account (SESA), the US Bureau of Economic Analysis has (BEA) developed, with the support of many stakeholders in the space community and beyond, a list of 200 commodity codes that relate to space activities. These commodities and their codes are provided below for information purposes. They use long "NAICS-based codes", as in the North American Industry Classification System (NAICS), US industries are defined at the six-digit level. For use in its economic census and survey programmes, a number of administrations, including the BEA, have developed "NAICS-based codes" with codes greater than six digits to allow detailed analysis.

**Annex Table 2.A.1. List of space commodities used in the US Space Economy Satellite Account**

Commodity code	Commodity description
2332711	New air transportation structures – private
2332712	New air transportation structures – federal
2332713	New air transportation structures – S&L
5151102	Air-time sales for the broadcasting of radio program content
5151104	Public and non-commercial programming services – Radio (includes contributions, gifts, and grants)
5151202	Air-time sales for the broadcasting of television program content
5151204	Public and non-commercial programming services – TV (includes contributions, gifts, and grants)
5171101	Basic fixed local telephony (other than telecom resellers) – (Includes subscriber line and calling feature charges)
5171102	Basic fixed long distance and all distance telephony (other than telecom resellers)
5171104	Multichannel programming distribution services (analog and digital) (includes start-up and reconnect fees)
5171109	Broadband (always on) internet access services
5174101	Satellite telecommunications services – (includes carrier services and private network services of satellite telecommunications)
5413301	Engineering services
5415111	Custom computer programming
5415113	Own-account software
5419909	All other professional, scientific, and technical services
23326221	New other educational structures, incl. museums and libraries – private
23326222	New other educational structures, incl. museums and libraries – federal
23326223	New other educational structures, incl. museums and libraries – S&L
48100011	Air transportation, passenger transport-domestic
48100041	Air transportation, other
51121011	Application software publishing (other than games)
51121012	System software publishing
51511035	Licensing of rights to broadcast radio programs
51512035	Licensing of rights to broadcast television programs
51521035	Licensing of rights to distribute specialty television or audio programming content
51711010	Internet telephony
51711011	Force account, telephone equipment installation
51711039400	Licensing of rights to use intellectual property of wired telecom carriers
51791139400	Licensing of rights to use intellectual property of telecom resellers
51791939400	Licensing of rights to use intellectual property of all other telecommunications

Commodity code	Commodity description
54133039400	Licensing of rights to use intellectual property of engineering services
54137039400	Licensing of rights to use intellectual property of surveying and mapping (except geophysical) services
3333143333143	All other miscellaneous optical instruments and lenses
3341113341111	Host computers, multiusers (mainframes, super computers, medium scale systems, UNIX servers, PC servers)
3341113341117	Single user computers, microprocessor-based, capable of supporting attached peripherals (personal computers, workstations, portable computers)
3341183341181	Computer terminals (excl. parts/attachments/accessories/etc.)
3342203342205	Radio station equipment including satellite, airborne and earth-based (fixed and mobile)
3342903342903	Intercommunications systems, including inductive paging systems (selective paging), except telephone and telegraph
3345113345111	Aeronautical, nautical, and navigational Instruments not sending or receiving radio signals
3345113345113	Search, detection, navigation, and guidance systems
3345193345192	Aircraft engine instruments (except flight)
3345193345194	Physical properties testing and inspection equipment and kinematic testing and measuring equipment
3345193345199	Survey/drafting instruments/apparatus, incl. photogrammetric
3364133364131	Aircraft propellers and helicopter rotors
3364133364136	Aircraft parts and auxiliary equipment, excl. hydraulic and pneumatic subassemblies
33411833411841	Parts, attachments, and accessories for computer terminals (except point-of-sale and funds-transfer devices)
33451933451991	Parts and components for drafting and photogrammetric and geodetic instruments
33641433641411	Complete guided missiles
33641433641451	Other services on complete guided missiles
33641433641473	Complete space vehicles (excluding propulsion systems)
33641533641511	Complete missile or space vehicle engines – US military
33641533641512	Complete missile or space vehicle engines – US nonmilitary
33641533641513	Complete missile or space vehicle engines – other customers
334516334516167	Parts-components and accessories for analytical and scientific instruments, sold separately
336419336419112	Missile/space vehicles airframes/capsules – US military
3342203342202199	Broadcast, studio parts and accessories
3342203342209109	Antenna systems, sold separately
3345193345195120	Physical properties testing and inspection equipment and kinematic testing and measuring equipment
3364153364155100	Other services, complete missiles/space veh. eng./prop. units
3364153364157101	Missile and space vehicle engines or propulsion parts and accessories-US military
3364153364157104	Missile and space vehicle engines or propulsion parts and accessories-US nonmilitary
3364153364157107	Missile and space vehicle engines or propulsion parts and accessories-other customers
3364193364191311	Missile/space vehicle components, etc. – US nonmilitary
3364193364191413	Missile/space vehicle components, etc. – other customers
325120325120C1	Argon and hydrogen
33231M332313346	Weldments and fabricated steel plate for other purposes
332710332710T	Machine shops
33281M332812T	Metal coating, engraving (except jewellery and silverware), and allied services to manufacturers
33291N3329121	Aerospace type hydraulic fluid power valves
33291N3329123	Aerospace type pneumatic fluid power valves
33399N33399671	Aerospace type fluid power pumps and motors
334111334111D1	Other Computers, including Array and Other analog, hybrid, and special purpose
334111334111W	Electronic computers nsk., total
334111AO	Electronic computer manufacturing other miscellaneous receipts
334111IC	Electronic computer manufacturing inventory change
334118334118IC	Computer terminal manufacturing inventory change
334118334118W	Computer terminals, nsk., total
334118AO	Computer terminal manufacturing other miscellaneous receipts
33422033422014X	Other communication systems and equipment
3342203342202X	Broadcast, studio, and related electronic equipment
3342203342203X	Wireless networking equipment
334220334220W	Radio and TV broadcasting and wireless communications equipment, nsk

Commodity code	Commodity description
334220AO	Radio and television broadcasting and wireless communications equipment manufacturing other miscellaneous receipts
334220IC	Radio and television broadcasting and wireless communications equipment manufacturing inventory change
334290334290W	Other communications equipment, nsk
334290AO	Other communications equipment manufacturing other miscellaneous receipts
334290IC	Other communications equipment manufacturing inventory change
334413334413T	Semiconductor and related device manufacturing
334413AO	Semiconductor and related device manufacturing other miscellaneous receipts
334413IC	Semiconductor and related device manufacturing inventory change
334417334417T	Electronic connectors
334417AO	Electronic connector manufacturing other miscellaneous receipts
334417IC	Electronic connector manufacturing inventory change
334419334419AO	Electron tube manufacturing other miscellaneous receipts
334419334419IC	Electron tube manufacturing inventory change
334419334419T	Electron tubes and parts, excluding glass blanks
334419334419W	Other electronic component manufacturing
334419AO	Other electronic component manufacturing other miscellaneous receipts
334419IC	Other electronic component manufacturing inventory change
334511334511W	Search, detection, navigation, and guidance systems, nsk.
334511AO	Search, detection, navigation, guidance, aeronautical, and nautical system and instrument manufacturing other miscellaneous receipts
334511IC	Search, detection, navigation, guidance, aeronautical, and nautical system and instrument manufacturing inventory change
334513334513012X	General-purpose control system instruments (commonly called receiver-type), operating from standardized transmission signals
334513334513021F	Continuous process instruments (pneumatic systems, including all system-type control, display and computing instruments)
3345133345130256X	Pressure and draft measuring instruments
3345133345130267X	Flow and liquid level measuring instruments
33451333451302X	Temperature measuring instruments, Thermocouples, and Humidity Instruments
33451333451303X	Parts for process control instruments
334513AO	Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables other miscellaneous receipts
334513IC	Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables inventory change
334513RW	Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables repair work
334515334515T	Instruments to measure electricity
334515AO	Instrument manufacturing for measuring and testing electricity and electrical signals other miscellaneous receipts
334515IC	Instrument manufacturing for measuring and testing electricity and electrical signals inventory change
334515RW	Instrument manufacturing for measuring and testing electricity and electrical signals repair work
3345163345160X	Analytical and scientific instruments, except optical
334516AO	Analytical laboratory instrument manufacturing Other miscellaneous receipts
334516IC	Analytical laboratory instrument manufacturing Inventory change
334516RW	Analytical laboratory instrument manufacturing repair work
3345193345195A	Nuclear radiation detection and monitoring instruments
3345193345197C	Seismic instruments
334519334519W	Watches, clocks, parts, other measuring and controlling devices, nsk.
335991335991T	Carbon and graphite products
335991AO	Carbon and graphite product manufacturing Other miscellaneous receipts
335991IC	Carbon and graphite product manufacturing Inventory change
336413336413W	Aircraft parts and auxiliary equipment, nec., nsk. total
336413AO	Other aircraft parts and auxiliary equipment manufacturing Other miscellaneous receipts
336413IC	Other aircraft parts and auxiliary equipment manufacturing inventory change
336414336414A101	All other services on complete space vehicles for US govt. military customers



Commodity code	Commodity description
336414336414A104	All other services on complete space vehicles for other customers
336414336414AY	All other services on complete space vehicles, nsk.
336414336414W	Guided missile and space vehicle manufacturing, nsk.
336414AO	Guided missile and space vehicle manufacturing Other miscellaneous receipts
336414IC	Guided missile and space vehicle manufacturing inventory change
3364153364157Y	Missile and space vehicle engines or propulsion parts and accessories, nsk.
336415336415W	Space propulsion units and parts, nsk.
336415AO	Guided missile and space vehicle propulsion unit and propulsion unit parts manufacturing other miscellaneous receipts
336415IC	Guided missile and space vehicle propulsion unit and propulsion unit parts manufacturing inventory change
336419336419W	Other guided missile and space vehicle parts and auxiliary equipment, nsk.
336419AO	Other guided missile and space vehicle parts and auxiliary equipment manufacturing other miscellaneous receipts
336419IC	Other guided missile and space vehicle parts and auxiliary equipment manufacturing inventory change
3391133391136Y	Personal industrial and nonindustrial safety equipment and clothing, nsk.
5241XX2810	Aircraft Insurance (property and casualty)
541330CM	Construction management services
541360T	Geophysical surveying and mapping services
541370T	Surveying and mapping (except geophysical) services
541380T	Testing laboratories
541512T	Computer systems design services
541519T	Other computer related services
541611T	Administrative management and general management consulting services
541690T	Other scientific and technical consulting services
54170AFS3364	For sale auxiliary scientific research and development (taxable) aerospace product and parts manufacturing
54170AFSM	For sale auxiliary scientific research and development (taxable) all other manufacturing industries
54170AFSNM	For sale auxiliary scientific research and development (taxable) all other non-manufacturing industries
54170NEFS3364	For sale academic scientific research and development (tax exempt) aerospace product and parts manufacturing
54170NEFS5417	For sale academic scientific research and development (tax exempt) scientific R&D services
54170NEFSFED	For sale academic scientific research and development (tax exempt), federal funded
54170NEFSM	For sale academic scientific research and development (tax exempt) all other manufacturing
54170NEFSNM	For sale academic scientific research and development (tax exempt) all other non-manufacturing
54170NFS3364	For sale scientific research and development (tax exempt) aerospace product and parts manufacturing
54170NFS5417	For sale scientific research and development (tax exempt) scientific R&D services
54170NFSM	For sale scientific research and development (tax exempt) all other manufacturing
54170NFSNM	For sale scientific research and development (tax exempt) all other non-manufacturing
54170NFSNPFED	For sale scientific research and development (tax exempt) all other non-profit industries, federal funded
54170NOAFGD	Own account scientific research and development (tax exempt) federal government defence
54170NOAFGND	Own account scientific research and development (tax exempt) federal government non-defence
54170PFS3364	For sale scientific research and development (taxable) aerospace product and parts manufacturing
54170PFS5417	For sale scientific research and development (taxable) scientific R&D services
54170PFSM	For sale scientific research and development (taxable) all other manufacturing industries
54170PFSNM	For sale scientific research and development (taxable) all other non-manufacturing industries
54170POA3364	Own account scientific research and development (taxable) aerospace product and parts manufacturing
54170POA5417	Own account scientific research and development (taxable) scientific R&D services
54170POAM	Own account scientific research and development (taxable) all other manufacturing
54170POANM	Own account scientific research and development (taxable) all other non-manufacturing
5418XX11	Radio, television, and cable advertising
61123N01	Expenses of colleges, universities, professional schools, and junior college education services (tax exempt)
61123N02	Expenses of colleges, univ., prof. schools, junior college incidental to education activities (tax exempt)
61123N03	Expenses of colleges, universities, professional schools, and junior college research and development (tax exempt)
61123NR01	Tax exempt receipts from sales of colleges, universities, professional schools, and junior colleges education services (tax exempt)
61123NR02	Tax exempt receipts from sales of colleges, univ., prof. schools, jr colleges incidental to educ. Activities (tax exempt)
61123P01	Colleges, universities, professional schools, and junior colleges higher education services (taxable)

Commodity code	Commodity description
61123P02	Sales and svcs, colleges, univ., prof. Schools, jr. colleges incidental to education activities (taxable)
71210N1	Cultural institutions -- expenses
71210NRT	Cultural institutions -- tax exempt receipts
71210PT	Cultural institutions (taxable)
99FD02T	Federal defence government services
99FN02T	Federal non-defence government services
99S392T	S&I other general government services

Note: More information on the US Space Economy Satellite Account can be found in Highfill, Jouard and Franks (2020<sup>[2]</sup>), "Preliminary estimates of the U.S. space economy, 2012–2018", <https://apps.bea.gov/scb/2020/12-december/1220-space-economy.htm>.

## Annex 2.B. European classification codes for selected space products and services

The following table provides some concordance for selected space products and services identified in European and international classifications at different digit levels. Relevant frameworks include the Statistical Classification of Economic Activities in the European Community (NACE), as well as the Statistical Classification of Products by Activity in the European Union, Version 2.1 (CPA). CPA is the European version of the CPC (Central Product Classifications) of the United Nations. It is more detailed, it has a slightly different structuring which corresponds at all levels to that of NACE. In addition, PRODCOM statistics aim at providing a full picture at European Union level of developments in industrial production for a given product or for an industry in a comparable manner across countries. PRODCOM uses an eight-digit numerical code, the first six digits of which are, in general, identical to those of the CPA code. The headings of the PRODCOM list are also derived from the international Harmonized System (HS) or the Combined Nomenclature (CN), which enables comparisons to be made between production statistics and foreign trade statistics.

**Annex Table 2.B.1. Concordance table for selected space products and services**

NACE	ISIC	CPA 2.1	Description	PRODCOM 2014	HS/CN
<b>Manufacturing</b>					
30.3 Manufacture of air and spacecraft and related machinery	3030	30.30.13	Reaction engines, excluding turbojets	30.30.13.00	
		30.30.40	Spacecraft (including satellites) and spacecraft launch vehicles	30.30.40.00 (Spacecraft, satellites and launch vehicles, for civil use)	88026010 8826090
		30.30.50	Other parts of aircraft and spacecraft	30.30.50.50 (Undercarriages and parts thereof for dirigibles, gliders, hang gliders and other non-powered aircraft, helicopters, aeroplanes, spacecraft and spacecraft launch vehicles, for civil use)	880320
				30.30.50.90 (Parts for all types of aircraft excluding propellers, rotors, undercarriages, for civil use)	8839010 8839020 8839030
33.16 Repair and maintenance of aircraft and spacecraft	3315	33.16.10	Repair and maintenance of aircraft and spacecraft	33.16.10.00 (Repair and maintenance of civil aircraft and aircraft engines)	
25.62 Machining	2562	25.62.10	Turning services of metal parts	25.62.10.07 (Turned metal parts for aircraft, spacecraft and satellites)	
26.3 Manufacture of communications equipment	2630	26.30.22	Telephones for cellular networks or for other wireless networks	26.30.22.00 (Telephones for cellular networks or for other wireless networks)	851712
		26.30.23	Other telephone sets and apparatus for transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network)	26.30.23.10 (base stations)	851761
				26.30.23.20 (Machines for the reception, conversion and transmission or regeneration of voice, images or other data, including switching and routing apparatus)	851762
26.51 Manufacture of instruments and appliances for	2651	26.51.11	Direction-finding compasses; other navigational instruments and appliances	26.51.11.50 (Instruments and appliances for aeronautical or space navigation (excluding compasses))	90142020 90142080

NACE	ISIC	CPA 2.1	Description	PRODCOM 2014	HS/CN				
measuring, testing and navigation		26.51.12	Rangefinders, theodolites and tachymeters (tachometers); other surveying, hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances	26.51.12.15 (Electronic rangefinders, theodolites, tacheometers and photogrammetrical instruments and appliances)	90151010				
				26.51.12.35 (Electronic instruments and apparatus for meteorological, hydrological and geophysical purposes (excluding compasses))	90152010				
				26.51.12.39 (Other electronic instruments)	90154010				
				26.51.12.70 (Surveying (including photogrammetrical surveying), hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances (excluding levels and compasses), non-electronic; rangefinders, non-electronic)	90151090, 90152090, 90154090, 90158091, 90158093, 90158099				
		26.51.20	Radar apparatus and radio navigational aid apparatus	26.51.20.20	852610				
				26.51.20.50	85269120				
					85269180				
26.51.81	Parts of radar apparatus and radio navigational aid apparatus	26.51.81.00							
26.52 Watches and clocks	2652	26.52.13	Instrument panel clocks and clocks of a similar type for vehicles	26.52.13.00 (Instrument panel clocks and clocks of a similar type for vehicles, aircraft, spacecraft or vessels (including vehicle chronographs))	9104				
26.70 Manufacture of optical instruments and photographic equipment	2670	26.70.21	Sheets and plates of polarising material; lenses, prisms, mirrors and other optical elements (except of glass not optically worked), whether or not mounted, other than for cameras, projectors or photographic enlargers or reducers	26.70.21.53 (Prisms, mirrors and other optical elements, n.e.c.)	900190				
				26.70.21.55 (Mounted lenses, prisms, mirrors, etc., of any material, n.e.c.)	900290				
				26.70.21.70 (Mounted objective lenses of any material (excluding for cameras, projectors or photographic enlargers or reducers))	900219				
				26.70.21.80 (Unmounted sheets and plates of polarising material; mounted filters of any material)	900120 900220				
				26.70.22	Binoculars, monoculars and other optical telescopes; other astronomical instruments; optical microscopes	26.70.22.50 (Instruments (excluding binoculars) such as optical telescopes)	900580		
				26.70.23	Liquid crystal devices; lasers, except laser diodes; other optical appliances and instruments n.e.c.	26.70.23.30 (Lasers (excluding laser diodes, machines and appliances incorporating lasers))	901320		
				<b>Selected services</b>					
				43.21 Specialised construction activities	4321	43.21.10	Electrical installation works (including installation of satellite dishes)	n.a.	
				51.22 Space transport	5120	51.22.11	Space transport services of passengers	n.a.	
						51.22.12	Space transport services of freight	n.a.	
	6512	65.12.33	Other aircraft insurance services	n.a.					

NACE	ISIC	CPA 2.1	Description	PRODCOM 2014	HS/CN
65.12 Non-life insurance (includes motor, marine, aviation and transport insurance)			(including space transport)		
		65.12.36	Freight insurance services (including space transport)	n.a.	
71.1 Engineering activities and related technical consultancy: - geophysical, geologic and seismic surveying - geodetic surveying activities - land and boundary surveying activities - hydrologic surveying activities - subsurface surveying activities - cartographic and spatial information activities	7110	71.12.34	Surface surveying services (includes surveying by satellites)	n.a.	
		71.12.35	Map-making services (includes satellite surveying)	n.a.	
74.90 Other professional, scientific and technical activities n.e.c., including - weather forecasting activities - security consulting - agronomy consulting - environmental consulting - other technical consulting	7490	74.90.13	Environmental consulting services	n.a.	
		74.90.14	Weather forecasting and meteorological services	n.a.	
		74.90.19	Other scientific and technical consulting services n.e.c.	n.a.	
61.3 Satellite telecommunications activities	6130	61.30.10	Satellite telecommunications services, except home programme distribution services via satellite	n.a.	
		61.30.20	Home programme distribution services via satellite	n.a.	

Note: n.a.= Not applicable.

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