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Introducing the *OECD Handbook on Measuring the Space Economy*

This chapter introduces the *OECD Handbook on Measuring the Space Economy*. It describes the background, outlines the objectives and the target audience for the report and explains changes introduced since the first edition of the *Handbook*.

What is the *OECD Handbook on Measuring the Space Economy*?

In 2012, the OECD published its *Handbook on Measuring the Space Economy*. It resulted from the work of the OECD Space Forum and benefited from extensive consultation in the space community and beyond. The *Handbook* represented the first international effort to systematically define and measure the “space economy” and its constituent economic activities (OECD, 2012^[1]). Since then, the definition of the space economy provided in the publication has been extensively adopted by governments and the private sector alike.

Much has changed in the space economy over the past decade, with an ever-growing number of countries and business enterprises involved in space activities. Despite the development of new and improved surveys in many parts of the world and overall progress in the quality of publicly available data, the international comparability of space economy statistics remains limited. It is therefore time to provide a revision of the *OECD Handbook on Measuring the Space Economy* (the *Handbook* herein) to reflect the changing landscape of space activities, space technologies and subsequent evolving user needs.

The objectives of this second edition of the *Handbook* are to encourage and facilitate data collection among both incumbent and new actors involved in space activities, respond to the needs of the public agencies that still fund the bulk of space programmes and provide an introduction to industry and private decision makers who will also benefit from improved statistics on the space economy.

This revised version aims to share the lessons learnt from the government sector and business enterprises in measuring the space economy and help stakeholders develop adequate measurement strategies to support their evidence-based decision-making. It builds on key concepts, definitions, and practices, which can be found in international guidelines such as the *Frascati* and *Oslo Manuals*. Readers are encouraged to review and adopt the international guidelines in their statistical practices (OECD, 2015^[2]; OECD/Eurostat, 2018^[3]).

Against this backdrop, the *Handbook* provides a set of Chapters that illustrate how an analyst might:

- use pragmatically the recent progress in concepts, definitions and measurement of the space economy (Chapter 2)
- follow the evolving cast of space actors for measurement purposes (Chapter 3)
- track the performance and evolutions of the space economy with industry surveys and their indicators (Chapter 4)
- and compare the effects of space activities over time, and as compared to other economic activities (Chapters 5).

Measuring the space economy will remain an evolving field as commercial space activities, in particular, are changing fast. Further revisions of the *Handbook* are therefore likely to be required as the space economy changes and new statistical practices are adopted.

As with all statistical companions published by the OECD, the audience for this *Handbook* includes a broad range of users. They are likely to include:

- policymakers and representatives of government agencies that form a major part of the demand for more detailed information on the space economy
- commercial actors active in the space community and beyond, many of whom have contributed data and analysis for this *Handbook*
- researchers in different disciplines and analysts who interpret statistical information and need to access the methodologies that underlie that information
- and, finally, international organisations whose information requirements centre on comparability across countries.

Why and how was the *Handbook* revised?

The OECD Space Forum is a group of space agencies and ministries from ten countries (at time of writing) and the European Space Agency. Together, they contribute to improving knowledge of the economics of space activities to support evidence-based policies nationally and internationally. The pervasiveness of space applications in many daily activities is growing and there are an increasing number of commercial space activities. The Forum therefore decided in 2012 that definitions of the space economy should not be limited to a few characteristics only (i.e. space launchers and satellites).

A comprehensive view of the space economy was supported by experts in several workshops and during broad consultations with diverse administrations, industry associations, as well as small and large stakeholders in the private sector. Using lessons learnt from other sectors, a definition of the space economy that encompasses the many dimensions of programmes, services and actors was established. The following working definition formed the starting point for the first *Handbook on Measuring the Space Economy* (OECD, 2012^[1]).

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^[1]).

This definition has been used extensively by the space community and public bodies, albeit with some differing interpretations on which activities to include in specific segments of the space economy.

New challenges in terms of measurement and delineation

Since the publication of the first edition of the *Handbook*, the landscape of space activities has undergone significant changes (see for instance OECD (2014^[4]; 2019^[5]; 2020^[6]; 2021^[7])) with new important challenges for measuring the space economy.

The sector has undergone structural changes, as the lowered cost of access to space places higher emphasis on digital assets. Business enterprise activities increasingly span across entire sections of the space economy value chain. Many space start-ups engage in both manufacturing and data exploitation. Large space-manufacturing incumbents are moving further down the value-chain to reach final customers outside of the traditional government sector.

As the digitalisation of the economy increases apace, the exploitation of satellite data and signals is playing an increasingly important role in the generation of societal value. However, the lines between space and non-space activities are becoming more blurred. New data economy actors and activities are entering the space economy and satellite data are increasingly used alongside other data sources in the “mainstream” economy. This makes it difficult to attribute the value generated through certain activities to the space economy.

Finally, the announcement and early deployment of mega-constellations for satellite broadband in the low-earth orbit and the involvement of several major information and communication technology enterprises in the sector has created significant optimism on market prospects. Space activities are attracting more interest from public and private investors.

Table 1.1 contains estimates of the size of the space economy taken from various recent publications. According to some financial estimates, the space economy may surpass USD 1 trillion by 2040 (Morgan Stanley, 2020^[8]). In comparison, a more conservative study conducted by the US Institute of Defense Analyses estimated the size of the space economy in 2016 at USD 167 billion, suggesting that the space economy should be measured in terms of value added, not revenues (Crane et al., 2020^[9]).

The great discrepancy in estimates is therefore largely due to the use of different definitions and delimitations of the space economy. In particular, the inclusion or exclusion of services supporting consumer markets such as direct-to-home television, and consumer applications relying on global navigation satellite systems (GNSS) signals. Many of the consumer products used to access satellite capacities (e.g. satellite dishes, set-top boxes) often included in estimates, may actually be imports from third countries with limited space investments. In addition, different methodologies are used to estimate the value of space products and services, measuring either output (i.e. revenue) or value added (i.e. output minus intermediate inputs), and in most cases double-counting government-funded space activities, thus not making obvious to the readers what is actually included in the estimates.

Table 1.1. Recent estimates of the space economy

Organisation	Current estimates (2016)	Forecasts (2040)	General comments	Activities and sector(s) included in space economy estimates
Satellite Industry Association	USD 339.1 billion	n.a.	Space economy estimate includes both government budgets and commercial revenues, which may inflate the final estimate, as commercial actors have many government customers	Government budgets, satellite services (telecommunications and remote sensing), ground equipment (network equipment and consumer equipment), satellite manufacturing, launch industry, commercial human spaceflight
Morgan Stanley	USD 350 billion	USD 1.1 trillion	Based on SIA data, with forecast based on 5% compound annual growth rate, driven by internet and consumer broadband	
Merrill Lynch/Bank of America		USD 2.7 trillion	Similar starting definition as SIA and Morgan Stanley, with growth forecast based on 7% compound annual growth rate, highlighting the “cislunar” economy, e.g. Internet, on-orbit services and resource extraction	
Space Foundation	USD 329.3 billion	n.a.	Same potential issue of double-counting as the SIA estimate	Government space budgets, commercial space products and services, commercial infrastructure and support industries
Institute for Defense Analyses	USD 166.8 billion	n.a.	Measures value added, not revenues	Government budgets, revenues from satellite services and space service user support

Note: n.a.=Not available.

Sources: OECD (2019^[5]), *The Space Economy in Figures*, <https://dx.doi.org/10.1787/c5996201-en> and Crane et al. (2020^[9]), “Measuring the space economy: Estimating the value of economic activities in and for space”, www.ida.org/-/media/feature/publications/m/me/measuring-the-space-economy-estimating-the-value-of-economic-activities-in-and-for-space/d-10814.ashx.

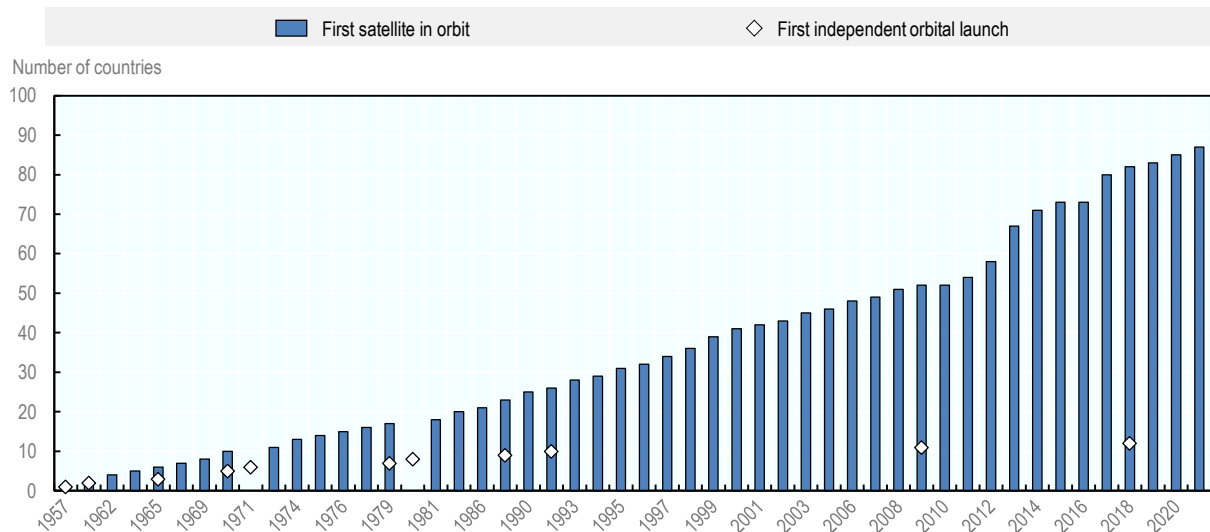
Statisticians and economists must therefore grapple with the question of where to draw the line between space and non-space activities. Should mobility services relying on GNSS signals be included in the space economy? What about business enterprises using satellite imagery along with multiple other non-space related types and data in their analysis?

More government space actors and a growing body of evidence

More government actors pursuing different objectives are engaged in space activities than ever before. Since the launch of Sputnik in 1957, more than 80 countries have registered a satellite in orbit. The rate at which new countries are launching satellites to orbit has increased over the last decade (Figure 1.1). Since the early 2000s, more than 30 new space agencies or offices have been established on all six continents and in both high and lower-income economies (ESPI, 2020^[10]).

Figure 1.1. Almost 80 countries have registered a satellite in orbit

Number of countries having registered a satellite in orbit and/or launched a rocket successfully



Source: Updated from OECD (2019^[5]), *The Space Economy in Figures*, <https://dx.doi.org/10.1787/c5996201-en>.

In parallel, studying the economics of space activities has become increasingly professionalised. A number of space administrations now employ specialist teams of economists and other analytical professions (e.g. Canadian Space Agency (CSA), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), UK Space Agency (UKSA), the French space agency (CNES), Korea Aerospace Research Institute (KARI), Italian Space Agency (ASI)) and/or are dedicating resources to data collection through surveys. Increasingly, partnerships are being built with national statistical offices (OECD, 2020^[11]). In the same vein, the European Space Agency (ESA) has created a dedicated Space Economy unit. The ESA unit works to improve economic measurement and collect and share best practices in socio-economic impact assessment in co-operation with the OECD Space Forum, ESA member states and relevant government entities involved in economic analysis and statistics (European Space Agency, 2021^[12]).

The need to better track the implementation and impacts of public expenditure in the space economy is increasing in most countries. Contributing to economic growth and societal wellbeing are now key objectives of most government space strategies. This needs to be better reflected in data and indicators. In addition, the number of industry associations and consulting firms involved in providing market studies has also grown. This trend is providing novel data but also sometimes-conflicting information on the space economy.

Some well-established datasets on space activities now go back to the early 1990s (e.g. Eurospace industry association survey, the CSA's State of the Canadian Space Sector survey), while several new

surveys and studies have been carried out in recent years. These include those conducted alongside national statistical offices to allow comparisons with other sectors of the economy as well as enriched analysis from the breadth of data these statistical agencies have. The US Space Economy Satellite Account (Highfill, Jouard and Franks, 2020^[13]), for example, is the first satellite account of its kind and is inspiring others internationally.

Other efforts include the most recent German Space Agency (DLR) industry survey, Australia's economic snapshot of its space industry (Australian Space Agency, 2021^[14]), the launch of the French space agency's Observatory of the Space Economy (CNES, 2021^[15]), the first United Arab Emirates space industry survey, a major Italian cost-benefit analysis analysing the impacts of public policies in the space sector (Università di Milano and Agenzia Spaziale Italiana, 2021^[16]), the measurement of Denmark's space economy (London Economics and Rambøll Management Consulting, 2016^[17]), and the methodological advances for valuing satellite earth observation data in our economies (GeoValue, 2021^[18]; Valuables Consortium, 2021^[19]).

Despite these many developments, data comparability across time, economic sectors and countries remains a challenge. This makes it difficult to compare assessments with each other and, ultimately, to evaluate confidently the value generated from public expenditure in the space economy.

Within this context, the OECD Secretariat launched a consultation process concerning the evolving definition of the space economy and the activities that take place within it. More than 100 organisations from national administrations, industry and professional associations were consulted. There was a broad consensus about standardising the overarching concept of the "space economy" in order to promote a common understanding and a common vocabulary. A standard definition may prove especially useful when distinguishing between different space activities and trying to assess the health and socio-economic impact of the space economy overall.

This *Handbook* recommends an approach to measurement that is as comprehensive as possible in order to provide the best available evidence to policymakers and decision makers in the space economy.

Process for revision

The new *Handbook* is the result of extensive OECD research activities on the economics of space activities conducted over the past six years with strong involvement from members of the OECD Space Forum. The process involved multilateral and bilateral consultations with experts from space agencies, public research centres, national statistical offices, intergovernmental organisations, academia and industry (from very small to large business enterprises). The research also benefited from insights collected during many technical seminars and workshops, each assembling between 30 and 120 participants, with more than 40 countries represented during the process. To illustrate:

- Online seminars, held on 4 May and 8 June 2021, on "Space Economy Measurement and Surveys": The objective of these seminars was to understand the state-of-play in ongoing space economy surveys and related analysis from countries around the world.
- Workshop, held on 9 October 2020, entitled "What's next for the Space Economy in the Era of Covid-19?" The workshop assembled agencies and space industry representatives discussing recent evolutions in statistical indicators.
- Workshop, held on 2 October 2019 at OECD Headquarters in Paris, entitled "Linking Policies and Indicators: A Fresh Look": The main objectives of the workshop were to: 1) highlight new strategies in place at national and regional levels to attract and sustain space industry and investments; and 2) review the availability and quality of existing and experimental indicators used by public organisations to take stock of recent or ongoing programme evaluations and impact assessments.
- A meeting of the group of Space Agencies Technology Transfer Officers, on 21 February 2019 at the International Space University in Strasbourg, France, entitled "Meeting on Technology Transfers from Space".

- Workshop, held on 27 April 2018 at OECD Headquarters, Paris, entitled “The Transformation of the Space Industry: Linking Innovation and Procurement”: The objective was to review administrations’ practices and their need for specific statistics.
- Workshop, jointly hosted by the OECD Space Forum and Space Agencies Technology Transfer Officers (SATTO), held on 21 June 2017 at the French space agency CNES, entitled “Technology Transfer and Commercialisation from Space Programmes: Enabling Conditions, Processes and Economic Impacts”.
- Workshop, held on 22-23 June 2017 at OECD Headquarters, Paris, on “Economic and Innovation Indicators for the Space Sector”: The main objective was to take stock of recent public efforts to collect and analyse data and indicators related to economic development and innovation in the space sector, sharing experiences with stakeholders from OECD countries and beyond, including industry associations.
- Workshop, held in Paris on 10-11 March 2016, at OECD Headquarters, Paris, entitled “Data to Decisions: Valuing the Societal Benefit of Geospatial Information”: The event was hosted by OECD and organised in collaboration with NASA, USGS and the GEOValue Community. It was the first technical workshop assembling so many economists and scholars from academia and research institutes to specifically discuss the value of geospatial information and satellite data. The workshop brought together around 100 participants from 22 countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ghana, Japan, Korea, Mexico, Netherlands, Nigeria, Norway, South Africa, Sweden, Switzerland, Uganda, United Kingdom, United States, and Viet Nam). (See Chapter 5 on impacts.)
- Workshop, held on 25 May 2015 at OECD Headquarters, Paris, entitled “Taxonomy in the Space Economy: Defining, Describing and Classifying Actors Engaged in Space Activities”: The main objectives of the workshop were to share practical information about taxonomies and data collection to support national policies and agencies’ priorities and to build consensus on basic definitions and perimeters for space-related activities to improve international comparability.

A non-exhaustive list of practitioners and experts who kindly contributed substance and comments from space agencies, ministries, and industry in the course of the project is provided in the acknowledgements at the beginning of the *Handbook*.

What are the main differences between this and the first edition of the *Handbook*?

The new *Handbook* updates and expands upon the first edition of the *Handbook* in the following broad areas:

- **Revised concepts and definitions for the space economy:** The aim is to clarify high-level definitions for practitioners and to encourage improved international comparability for organisations wishing to compare their results.
- **Main principles of industry surveys:** Building on best international practices (*Frascati* and *Oslo Manuals*) and an extensive review of more than 20 space industry questionnaires, key principles and practical advice are provided for organisations interested in developing space economy surveys. Original pointers and lessons learnt are provided, which may give new ideas to long-standing developers of surveys.
- **A statistical companion introducing a diversity of evaluation and impact assessments of space activities:** The *Handbook* does not provide a step-by-step approach in conducting evaluation and impacts assessments (there are existing resources that do not need to be

uplicated). However, it points to many existing studies of the impact of the space economy and explains different techniques that may be used.

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