

# US Department of Commerce's Space Economy Satellite Account Webinar

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July 29, 2020



# Webinar Outline

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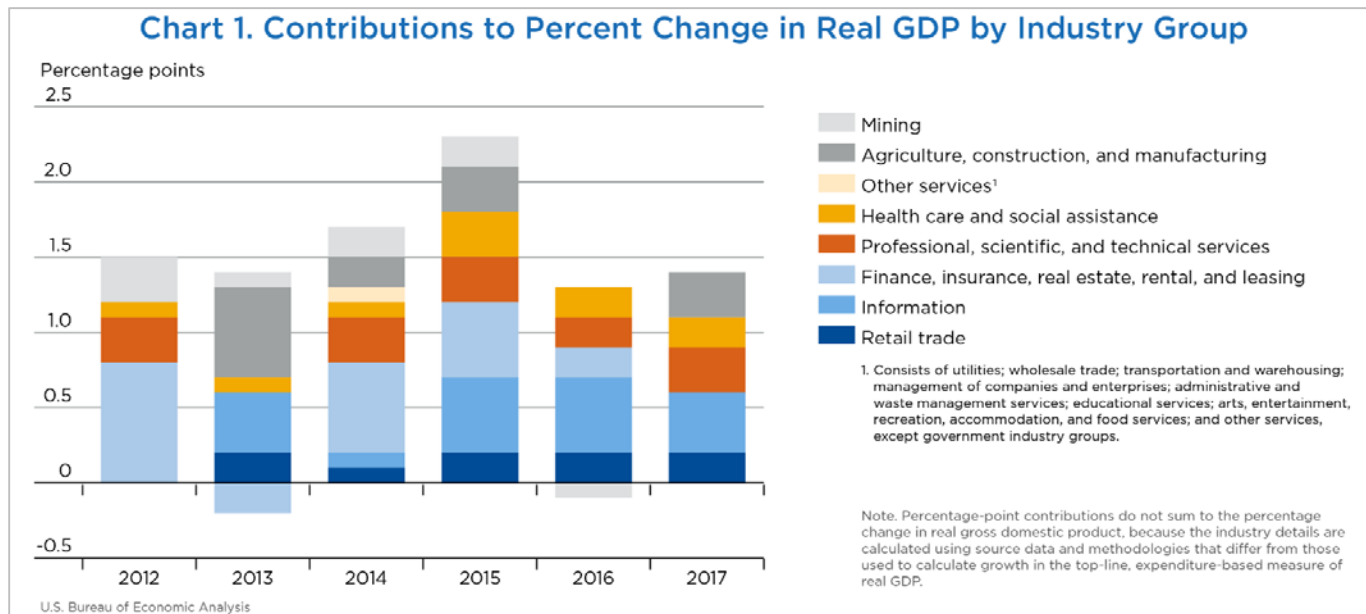
1. Overview of BEA statistics and economic satellite accounts
2. Defining and measuring the US space economy
3. Summary of feedback BEA has received from space economy stakeholders
4. Review data and methods BEA is using to develop the space economy satellite account statistics
5. Discuss FAQs and questions from participants
6. Timeline and next steps

*System of National Accounts (SNA)* provides the international standards for compiling macro-economic statistics. In addition to the **core set of accounts**, the 2008 *SNA* introduced **satellite accounts**, which are linked to the central framework of national accounts

BEA satellite accounts include: Space Economy, Digital Economy, Outdoor Recreation, Ocean Economy, and more

- Goal: Identifying and quantifying relevant commodities across industries
- Main challenges: Defining the phenomenon and accessing relevant data

**Gross domestic product (GDP)** is the value of the goods and services produced by the nation's economy *less* the value of the goods and services used up in production



These goods and services are categorized using the North American Industry Classification System ([NAICS](#)); for example, mining codes begin with '21'

**Gross output** measures the value of intermediate and final products and is similar to revenue

- $\text{Gross output} = \text{GDP} + \text{intermediate inputs}$

**Supply-use tables** provide the framework for gross output by industry statistics

- These statistics measure the production of commodities by industry and the distribution of sales for each commodity
- The main data source for the supply-use tables is the US Census Bureau. Other sources include US Treasury, IRS, and Bureau of Labor Statistics

# Supply-use tables

The **supply** or **make** table shows the value of each commodity produced by each industry

**Table 1. The Make of Commodities by Industries, 2009**  
[Millions of dollars]

Industries/commodities	Agriculture, mining, and construction <sup>1</sup>	Manufacturing		Services <sup>2</sup>	Government <sup>3</sup>	Total industry output <sup>4</sup>
		Total	Computer and electronic products			
Agriculture, mining, and construction <sup>1</sup> .....	1,761,954	16,925	.....	2,086	.....	1,780,964
Manufacturing .....	4,292	4,418,259	331,611	95,976	.....	4,522,360
Computer and electronic products .....	105	338,868	321,839	14,299	.....	353,273
Services <sup>2</sup> .....	40,176	18,669	56	15,280,753	1,429	15,341,784
Government <sup>3</sup> .....	25,723	7,750	.....	561,221	2,559,377	3,159,049
<b>Total commodity output .....</b>	<b>1,832,144</b>	<b>4,461,601</b>	<b>331,666</b>	<b>15,940,037</b>	<b>2,560,806</b>	<b>24,804,156</b>

Source: Streitwieser, M.L., 2010. *Measuring the nation's economy: an industry perspective*. Bureau of Economic Analysis.

# Supply-use tables

The **use** table shows the uses of commodities by industries as intermediate inputs and by “final users”

GDP = production value of goods and services consumed by final users

**Table 2. The Use of Commodities by Industries, 2009**  
[Millions of dollars]

Commodities/Industries	Agriculture, mining, and construction <sup>1</sup>	Manufacturing		Services <sup>2</sup>	Government <sup>3</sup>	Total intermediate use	Personal consumption expenditures	Private fixed investment	Change in private inventories <sup>4</sup>	Net trade	Government consumption and gross investment <sup>5</sup>	Total final uses (GDP)	Total commodity output
		Total	Computer and electronic products										
Agriculture, mining, and construction <sup>1</sup> .....	105,797	532,973	597	180,295	88,929	907,993	71,169	735,947	10,616	-202,876	309,294	924,151	1,832,144
Manufacturing.....	379,757	1,475,459	71,023	684,401	307,105	2,846,722	1,549,643	549,640	-114,720	-511,932	142,248	1,614,879	4,461,601
Computer and electronic products...	3,442	103,829	43,825	62,661	35,430	205,363	63,460	150,553	-7,858	-139,455	59,604	126,304	331,666
Services <sup>2</sup> .....	382,644	900,905	73,288	4,640,725	803,980	6,728,255	8,286,206	517,237	-18,893	369,193	58,038	9,211,781	15,940,037
Government <sup>3</sup> .....	137	2,351	37	67,730	12,040	82,259	66,753	.....	.....	268	2,411,527	2,478,547	2,560,806
<b>Total intermediate inputs<sup>6</sup>.....</b>	<b>869,524</b>	<b>2,937,526</b>	<b>146,845</b>	<b>5,641,525</b>	<b>1,236,542</b>	<b>10,685,116</b>	.....	.....	.....	.....	.....	.....	.....
Compensation of employees.....	486,889	858,645	120,852	4,840,778	1,633,206	7,819,518	.....	.....	.....	.....	.....	.....	.....
Taxes on production and imports less subsidies	37,165	69,977	5,634	879,971	-22,754	964,359	.....	.....	.....	.....	.....	.....	.....
Gross operating surplus	387,386	656,212	79,942	3,979,510	312,055	5,335,163	.....	.....	.....	.....	.....	.....	.....
<b>Total value added.....</b>	<b>911,440</b>	<b>1,584,834</b>	<b>206,428</b>	<b>9,700,259</b>	<b>1,922,507</b>	.....	.....	.....	.....	.....	.....	<b>14,119,040</b>	.....
<b>Total industry output.....</b>	<b>1,780,964</b>	<b>4,522,360</b>	<b>353,273</b>	<b>15,341,784</b>	<b>3,159,049</b>	.....	<b>10,001,329</b>	<b>1,716,426</b>	<b>-127,222</b>	<b>-386,397</b>	<b>2,914,905</b>	.....	<b>24,804,156</b>

Source: Streitwieser, M.L., 2010. *Measuring the nation's economy: an industry perspective*. Bureau of Economic Analysis.

# Supply-use tables

Make Table, Before Redefinitions, 2012 [Millions of Dollars] Bureau of Economic Analysis					
Industry / Commodity		Aircraft manufacturing	Aircraft engine and engine parts manufacturing	Other aircraft parts and auxiliary equipment manufacturing	Guided missile and space vehicle manufacturing
Code	Industry Description	336411	336412	336413	336414
336411	Aircraft manufacturing	100,972	154	3,526	873
336412	Aircraft engine and engine parts manufacturing	269	39,001	421	0
336413	Other aircraft parts and auxiliary equipment manufacturing	3,442	222	29,536	23
336414	Guided missile and space vehicle manufacturing	0			14,957

Use Table, Before Redefinitions, Purchasers' Value, 2012 [Millions of Dollars] Bureau of Economic Analysis							
Commodity / Industry		Total Intermediate	Personal consumption expenditures	Nonresidential private fixed investment in equipment	Exports of goods and services	Imports of goods and services	Federal national defense: Gross investment in
Code	Commodity Description	T001	F01000	F02E00	F04000	F05000	F06E00
336411	Aircraft manufacturing	20,602	720	29,141	44,049	-6,728	19,643
336412	Aircraft engine and engine parts manufacturing	30,432		524	25,236	-14,654	544
336413	Other aircraft parts and auxiliary equipment manufacturing	25,897			22,544	-12,539	
336414	Guided missile and space vehicle manufacturing	3,402		6,159	1,408	-106	5,883

Source: BEA 2012 supply-use tables <https://www.bea.gov/industry/input-output-accounts-data>



**Step 1:** Identify relevant commodities (goods and services) within BEA supply-use tables; we rely on past research and definitions, stakeholder feedback, and BEA expertise

**Step 2:** Separate economic activity within commodities, when necessary

**Step 3:** Use BEA supply-use tables to determine total economic activity by industry

# Defining the Space Economy

Existing definitions of the “space economy” are not specific enough for national accounting purposes

“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” (OECD, 2012, *OECD Handbook on Measuring the Space Economy*).

BEA’s *Survey of Current Business* article from December 2019 focused on existing definitions (Highfill, Georgi, and Dubria)

**Table 1. Sample of Existing Definitions and Concepts Related to the Space Economy and Commercial Space Activities**

Report or Organization	Space Economy Definitions and Concepts
Bureau of Industry and Security (2013, 5)	“ <b>Space-related [goods and services]</b> : Any product, service, or object that is a) used in or launched into space; b) used to directly or indirectly support space applications from Earth; and/or c) used to manufacture any product that is used in space or directly supports space applications”
Congressional Research Service (2012, 1)	“The <b>space industry</b> refers to economic activities related to the manufacture and delivery of components that go into Earth’s orbit or beyond”
Economics and Statistics Administration (1993, 11)	“ <b>US Commercial Space sector</b> revenues [come] from space-related goods and services to US private industries, export markets, and government procurement of commercial launch services and remote sensing data”

# Defining the Space Economy

Based on the broadest definition available (OECD), input from BEA experts, and data from the Bureau of Industry and Security U.S. Space Industry Deep Dive Assessment, an initial set of ~125 relevant commodity categories were identified

April 2020, BEA sent the list of potential space commodities to dozens of interested stakeholders and organizations (US and international) for feedback

Possible Space-related NAICS Industries and Commodities (sorted by NAICS code)			
Commodity Code	Commodity Description	Response (agree, disagree, no opinion, not sure)	Notes
221112T	Electric power generation		Includes solar energy generation
2332011	New office buildings, including financial buildings - private		Includes construction of
2332012	New office buildings, including financial buildings - federal		television offices and radio
2332013	New office buildings, including financial buildings - S&L		offices
2332251	New other commercial structures - private		Includes construction of
2332252	New other commercial structures - federal		commercial labs and research
2332253	New other commercial structures - federal		

# Stakeholder Feedback

Over a dozen organizations responded

Inter-rater reliability was calculated to determine the level of agreement about the commodities that should comprise the “space economy”

- Kappa statistics showed minimal agreement across stakeholders (~0.2)

Agreement was low even excluding for items marked with “unsure” or “no opinion”

## Interpretation of Cohen’s kappa.

Value of Kappa	Level of Agreement
0–.20	None
.21–.39	Minimal
.40–.59	Weak
.60–.79	Moderate
.80–.90	Strong
Above .90	Almost Perfect

Source: McHugh, M.L., 2012. Interrater reliability: the kappa statistic. *Biochemia medica*.

# Stakeholder Feedback

## Support for Inclusion in Space Economy Satellite Account, sorted by NAICS code

<b>Strong support (100-75% of raters agree)</b>	<b>Medium support (75-50%)</b>	<b>Low support (&lt;50%)*</b>
<ul style="list-style-type: none"> <li>• Construction of air transportation facilities and educational structures (23)</li> <li>• Manufacturing of optical instruments; telecommunications equipment; search, detection, navigation, and guidance systems; and space vehicles (333314, 33422, 33451, 33641)</li> <li>• Air transportation (48)</li> <li>• Software publishing (5112)</li> <li>• Satellite telecommunications services (5174)</li> <li>• Engineering and geophysical surveying and mapping services (54133, 54136)</li> <li>• Computer systems design (5415)</li> <li>• Aerospace research and development (5417)</li> <li>• Federal government services (99)</li> </ul>	<ul style="list-style-type: none"> <li>• Solar power generation (22111)</li> <li>• Construction of solar power structures (23)</li> <li>• Manufacturing of complete guided missiles (336414)</li> <li>• Wired telecommunications (51711)</li> <li>• Other telecommunications (5179)</li> <li>• Educational services (611)</li> <li>• Business and professional associations (8139)</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of TV and radio offices; roadway and structures providing access to launch areas (23)</li> <li>• Reference book publishers (5111)</li> <li>• Broadcasting (515)</li> </ul>

\*NAICS 515 and 5111 commodities were most likely to be marked as “unsure”

# Stakeholder Feedback

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Stakeholders have also given feedback outside of the commodity list exercise

- Exploitation of satellite data and imagery comes up often

While we determine definitions and continue outreach, we are moving forward

- Identifying and vetting data sources
- Analyzing initial estimates

# Estimating Space Activity: Satellite Telecommunications

## Step 1: Identify relevant commodities within supply-use tables

Commodity Code	Commodity Description
517410	Satellite Telecommunications

## Step 2: Separate space and non-space economic activity within commodities

“This industry comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”

2017  
NAICS  
517410  
517410  
517410  
517410  
517410  
517410

### Corresponding Index Entries

Earth stations for satellite communication carriers  
Long-distance telephone satellite communication carriers  
Resellers, satellite telecommunication  
Satellite telecommunication carriers  
Satellite telecommunication resellers  
Telephone communications carriers, satellite

Source: US Census Bureau, NAICS search <https://www.census.gov/cgi-bin/sssd/naics/naicsrch>

→ In certain cases, commodities are completely space-related

# Estimating Space Activity: Satellites

## Step 1: Identify relevant commodities within supply-use tables

Commodity Code	Commodity Description
334220	Broadcast and wireless communications equipment

## Step 2: Separate space and non-space economic activity within commodities

Code	Description	2012 Val (\$000s)
33422051	Radio station equipment	2,898,376
3342205104	Space-based (satellite) stations	2,103,391
3342205109	Airborne and marine-based stations	183,027
3342205114	Earth fixed-based systems	131,371
3342205116	Earth mobile-based systems	480,587

Source: US Census, "Manufacturing: Subject Series: Product Summary: Products or Services Statistics: 2012", [EC1231SP1](#)

**→ Census manufacturing data serve as the foundation for BEA's supply-use tables. Their product line data provides detailed information about manufacturing products**



# Estimating Space Activity: R&D

## Step 1: Identify relevant commodities within supply-use tables

Commodity Code	Commodity Description
54170_3364	Research and development, aerospace product and parts manufacturing

## Step 2: Separate space and non-space economic activity within commodities

<b>NSF Business R&amp;D Survey</b>		
Domestic R&D paid for by others and performed by the company, by business activity: 2012 (Millions of U.S. dollars)		
Business activity <sup>a</sup>	Business code <sup>b</sup>	2012
Aircraft manufacturing	33641	2876
Aircraft engine and engine parts manufacturing	33642	592
Other aircraft parts and auxiliary equipment manufacturing	33643	940
Guided missiles, space vehicles, and related parts manufacturing	33644	2273

Source: National Science Foundation, Business R&D and Innovation Survey, 2012

→ National Science Foundation data for 2012 indicate 34% of domestic aerospace R&D spending paid for by others was attributable to space activity

# Estimating Space Activity: Engineering Services

## Step 1: Identify relevant commodities within supply-use tables

Commodity Code	Commodity Description
541330	Engineering services

## Step 2: Separate space and non-space economic activity within commodities

### NAICS 541330 - Engineering Services

Display  records

Filter Table by Text: Text search table:

Occupation code	Occupation title (click on the occupation title to view an occupational profile)	Group	Employment	Employment RSE	Percent of total employment	Median hourly wage	Mean hourly wage	Annual mean wage	Mean wage RSE
17-2011	<a href="#">Aerospace Engineers</a>	detail	9,940	9.9%	1.03%	\$52.98	\$55.37	\$115,170	2.3%
17-3021	<a href="#">Aerospace Engineering and Operations Technicians</a>	detail	1,920	12.2%	0.20%	\$33.50	\$33.07	\$68,780	2.1%
19-2021	<a href="#">Atmospheric and Space Scientists</a>	detail	80	17.4%	0.01%	\$43.52	\$47.24	\$98,250	4.9%

Source: Bureau of Labor Statistics, 2018 Occupational Employment Survey, [https://www.bls.gov/oes/2018/may/naics5\\_541330.htm](https://www.bls.gov/oes/2018/may/naics5_541330.htm)

→ Bureau of Labor Statistics data for 2018 indicate 1.03% of employees in the engineering services industry were aerospace engineers

# Measurement Challenges

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Space-specific data availability is an issue for certain commodities, including broadcasting and telecommunications

Government production is significant and requires detailed reconciliations with budget documents to prevent double-counting

## 1. How will BEA's space economy estimates differ from existing reports?

- Definitional
- Economic concepts
  - Revenue versus value added (GDP)
  - Economic “impact” versus economic accounting
  - US space economy only—treatment of imports and exports

## 2. Are we include spending by the federal government and military?

- Yes

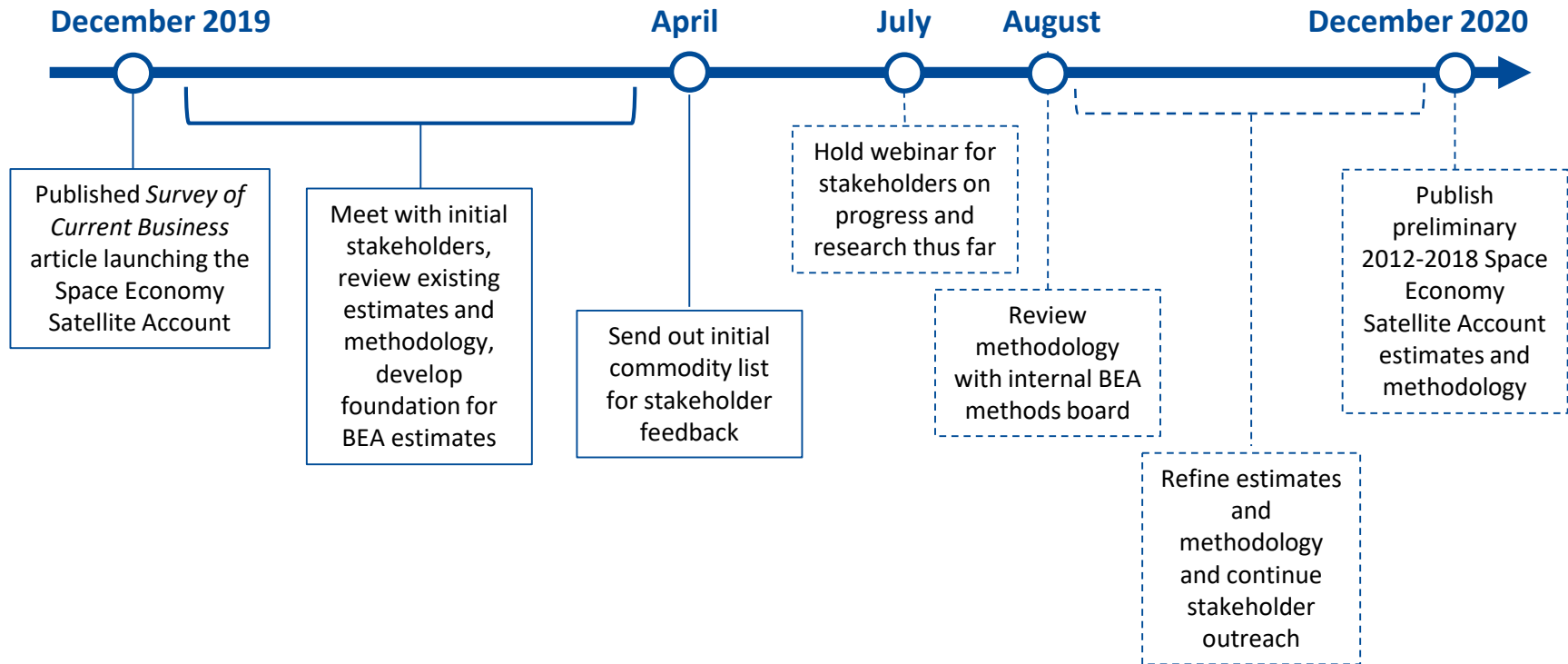
### **3. Are we using data from individual companies?**

- Our data are at the commodity-level, which combines products across companies, so we cannot see which companies produce each commodity

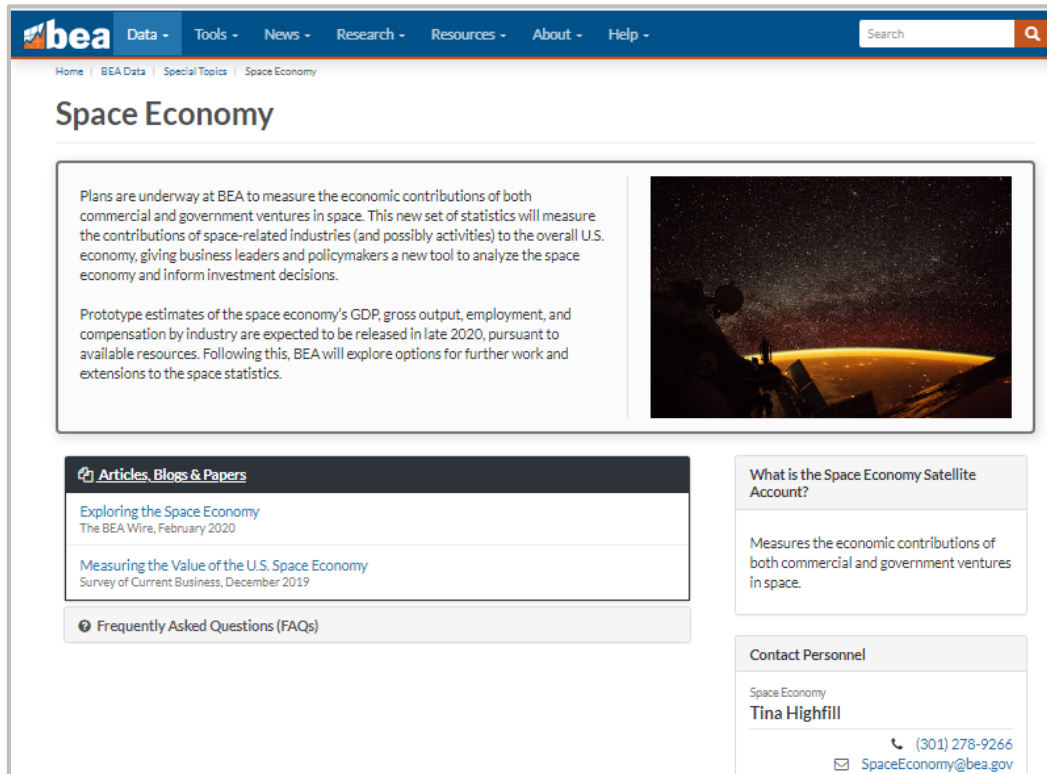
### **4. Will these data be updated every year?**

- The space economy satellite account is currently an unfunded research project. If funding is not received, these estimates will be a one-time project

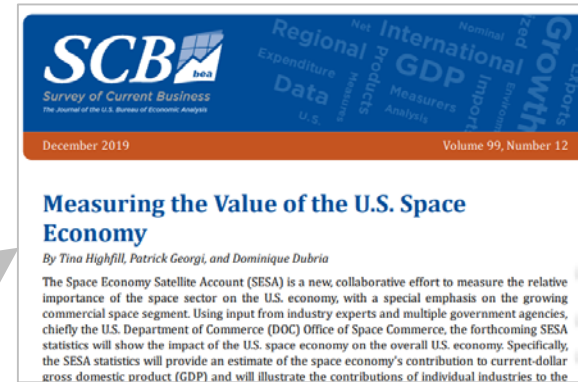
# Space Economy Satellite Account Timeline and Deliverables



# Space Economy Satellite Account Information



The screenshot shows the BEA website's "Space Economy" page. At the top, there is a navigation bar with "Data", "Tools", "News", "Research", "Resources", "About", and "Help". Below the navigation bar, the page title "Space Economy" is displayed. The main content area features a large introductory paragraph on the left and a photograph of a satellite launch on the right. Below the main text, there are three sections: "Articles, Blogs & Papers" with links to "Exploring the Space Economy" and "Measuring the Value of the U.S. Space Economy"; "What is the Space Economy Satellite Account?" which states it measures economic contributions of commercial and government ventures in space; and "Contact Personnel" listing Tina Highfill as the Space Economy contact with her phone number and email address.



The image shows the cover of the "Survey of Current Business" (SCB) journal, Volume 99, Number 12, published in December 2019. The cover features the BEA logo and the title "SCB Survey of Current Business". Below the title, there is a list of topics including Regional, International, GDP, Expenditure, Data, U.S., and Growth. The main article title "Measuring the Value of the U.S. Space Economy" is prominently displayed, along with the authors' names: Tina Highfill, Patrick Georgi, and Dominique Dubria.

## What is gross output by industry and how does it differ from gross domestic product (or value added) by industry?

Gross domestic product (or value added) by industry and gross output by industry are both published as part of BEA's industry accounts, and both sets of statistics provide important insights into an industry's contribution to the overall economy.

Gross output is principally a measure of sales or revenue from production for most industries, although it is measured as sales or revenue less cost of goods sold for margin industries like retail and wholesale trade. Intermediate inputs are the foreign and domestically-produced goods and services used up by an industry in the process of producing its gross output. Value added is the difference between gross output and intermediate inputs and represents the value of labor and capital used in producing gross output. The sum of value added across all industries is equal to gross domestic product for the economy. Value added is also measured as the sum of an industry's compensation of employees, taxes on production and imports, less subsidies, and gross operating surplus.

A simplified example illustrates how these different concepts are related. A manufacturer buys fiberglass, rubber, and aluminum to produce kayaks. The manufacturer uses energy to operate the facility and equipment used to mold and assemble the kayak hull and deck. The manufacturer employs one person to transport the finished kayaks to customers. In this case, the kayak manufacturer's gross output is the revenue earned from kayak sales. Intermediate inputs are the costs of operating the facility and the materials the manufacturer uses up in the production of kayaks. Value added equals the difference between the gross output and the cost of intermediate inputs. The manufacturer pays a portion of its value added as compensation to its employee, remits taxes to operate the business to the local government, and retains the remainder as profit.

Published: February 12, 2018

[bea.gov/data/special-topics/space-economy](https://www.bea.gov/data/special-topics/space-economy)

# Deliverables

Example of deliverables expected December 2020 using recently published Ocean Economy estimates:

## Economic Estimates:

**Table 2. Ocean Economy Value Added by Industry**  
[Millions of current dollars]

**Table 4. Ocean Economy Gross Output by Industry**  
[Millions of current dollars]

**Table 5. Ocean Economy Compensation by Industry**  
[Millions of current dollars]

**Table 6. Ocean Economy Employment by Industry**  
Thousands of full-time and part-time employees  
Bureau of Economic Analysis

	2014	2015	2016	2017	2018
All Industries	2,276	2,275	2,267	2,255	2,282
Private industries	1,584	1,596	1,593	1,582	1,603
Agriculture, forestry, fishing, and hunting	14	15	15	15	16
Mining	145	137	109	86	81
Oil and gas extraction	31	31	30	23	19
Mining, except oil and gas	5	5	5	5	6
Support activities for mining	109	101	74	58	56
Utilities	6	6	5	5	5
Construction	54	49	50	56	54
Manufacturing	119	122	124	110	116
Durable goods	87	90	93	80	87

## Methodology documentation:



**Defining and Measuring the U.S. Ocean Economy**

**Authors** William Nicolls, primary author; Connor Franks, Teresa Gilmore, Rachel Goulder, Luke Mendelsohn, and Edward Morgan, Bureau of Economic Analysis  
Jeffery Adkins, Monica Grasso, Kate Quigley, and Jennifer Zhuang, National Oceanic and Atmospheric Administration  
Charles Colgan, Middlebury Institute of International Studies at Monterey

**Contact** [william.nicolls@bea.gov](mailto:william.nicolls@bea.gov)

**Date** June 2020

**Abstract** The Bureau of Economic Analysis (BEA), in partnership with the National Oceanic and Atmospheric Administration (NOAA), has developed prototype statistics to measure the ocean's



# Contact Information

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Please reach out with feedback, questions, or comments

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Space Economy Satellite Account website:  
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DOC Office of Space Commerce website:  
[space.commerce.gov](https://space.commerce.gov)