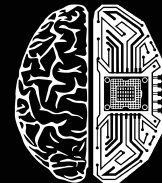


SpaceTech Government Activity 2021 / Q2 Landscape Overview

July 2021

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Executive Summary

The space age began in 1957 with a race between the US and USSR, but in the over half century since, many new countries have established space agencies and joined in. In the 21st century, the key players are fully equipped with needed cutting-edge spaceflight technologies, and they both compete and cooperate intensely with each other, the European Space Agency being the best example of the latter. The original players still have a significant advantage though; most satellites launched in the world are still launched, and still owned, by the US, Russia, and China.

However, the new players are starting to challenge the world space order, often being willing to allocate abundant resources to do so. Nations such as South Korea and the UAE aspire to become top-10 space countries. Luxembourg is attracting many private technology companies, as it strives to become a major European space hub. Some new entrants are developing independent space ecosystems with manufacturing and R&D capabilities, and some are cooperating in lunar and Mars programs. New players continue to join as the increasing technology growth grows the industry itself; Kenya and Bahrain have joined the list of countries operating satellites, and Argentina and Brazil lead Latin America. Australia and New Zealand have joined the race as well, but for most, the space industry remains underdeveloped with great growth potential.

In this context, an analysis of the National Space Agencies is of great value, as they play crucial roles in the development of their space industries. These roles are: Defining national aspirations; determining and implementing corresponding policies; coordinating space activities; allocating resources properly; and developing international and government-business cooperation. The latter is perhaps the most important, because such cooperation bears many benefits for all participants, including new commercial space companies, especially for emerging space nations.

SpaceTech Analytics (STA) is a leading strategic analytics agency focused on markets in Satellite Technology, Advanced Startups, Space Law, and Economics and other industries of SpaceTech.

STA is producing regular analytical reports on major areas of high potential in the space industries, maintaining ratings of companies and governments based on their innovation potential and business activity in the SpaceTech sphere, and providing strategic consulting to clients, including major investment funds, family offices, insurance companies, government organizations, and big companies among others.

Introduction

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Since the very beginning of the space age in 1957, countries all over the world have been investing in the development of space technologies. Initially, it was only the United States and USSR (now Russia), but soon Europe and China joined in the effort, and then many others. The creation of government agencies has accelerated during the past two decades, essentially doubling. The rate of progress for new agencies has increased as well, with the appearance of new and aggressive space nations. For example, the United Arab Emirates Space Agency was only formed in 2014, but it has already sent a space probe to orbit Mars.

Up until very recently, only government space agencies have performed planetary missions and human spaceflight, though that is changing rapidly. At first it was about launching satellites into orbit and probes to other planets, but today we have a set of rovers on Mars, a space station built with the cooperation of many different countries, space probes that have left Solar system and telescopes that will see the beginning of the universe. Much more is yet to come. Some agencies have concentrated on implementing high-precision Earth observation satellites, that will help with monitoring conditions on the planet. Others are building instruments that will answer a variety of big questions about physics and space.

While most people interested in space are familiar with the major government agencies, such as NASA and ESA, and their international cooperation on the ISS, the newer smaller players are relatively unknown. However, as demonstrated by the UAE, they are coming along rapidly. The cubesat revolution has enabled dozens of nations. The coming advent of very low-cost launch from systems like SpaceX's Starship/Superheavy will make it possible for smaller nations to participate in the upcoming boom in space activity, unimaginable only a few years ago. The purpose of this report is to highlight these lesser-known activities and players. In addition, it provides an overview of the top-50 space countries, including the primary players. Finally, prominent business cases for international and government-business cooperation are presented here as well.

Our Approach

Database	Applied Research & Analytics Methods		
<p>Identification of relevant:</p> <ul style="list-style-type: none">• Companies,• Investors,• Hubs,• Universities & Research Centers,• Government Ministries, Departments & Agencies,• Space Associations, <p>that operate, interact with or are somehow involved in the space industry.</p>	Descriptive Analysis	Mixed Data Research	Exploratory Data Analysis
	Comparative Analysis	Qualitative Data Collection	Data Filtering

Data Sources*					
Media Overview (Articles, Press Releases)	Industry-Specialised Databases	Publicly Available Sources (Websites)	Industry Reports and Reviews	Industry Leaders Interviews	Industry Leaders Interviews

Relying on various research methods and analytics techniques, the report provides a comprehensive overview of the space industry. This approach has certain limitations, especially when it comes to the leveraging of publicly available data sources and secondary research. SpaceTech Analytics is not responsible for the quality of the secondary data presented herein; however, we do our best to eliminate the said risks by using different analytical techniques and cross-checking data. Please note that we did not deliberately exclude certain companies from our analysis. In fact, the main reason for their non-inclusion was incomplete or missing information in the available sources. As for the Investors in the main database we include only institutional ones those who've invested in SpaceTech companies or SpaceTech-related companies. SpaceTech companies included in the database are those that are directly in the SpaceTech industry, or partially belong to it through working with clients from the SpaceTech industry, or there are separate departments in the company that work in this sector or cooperate with clients from it.

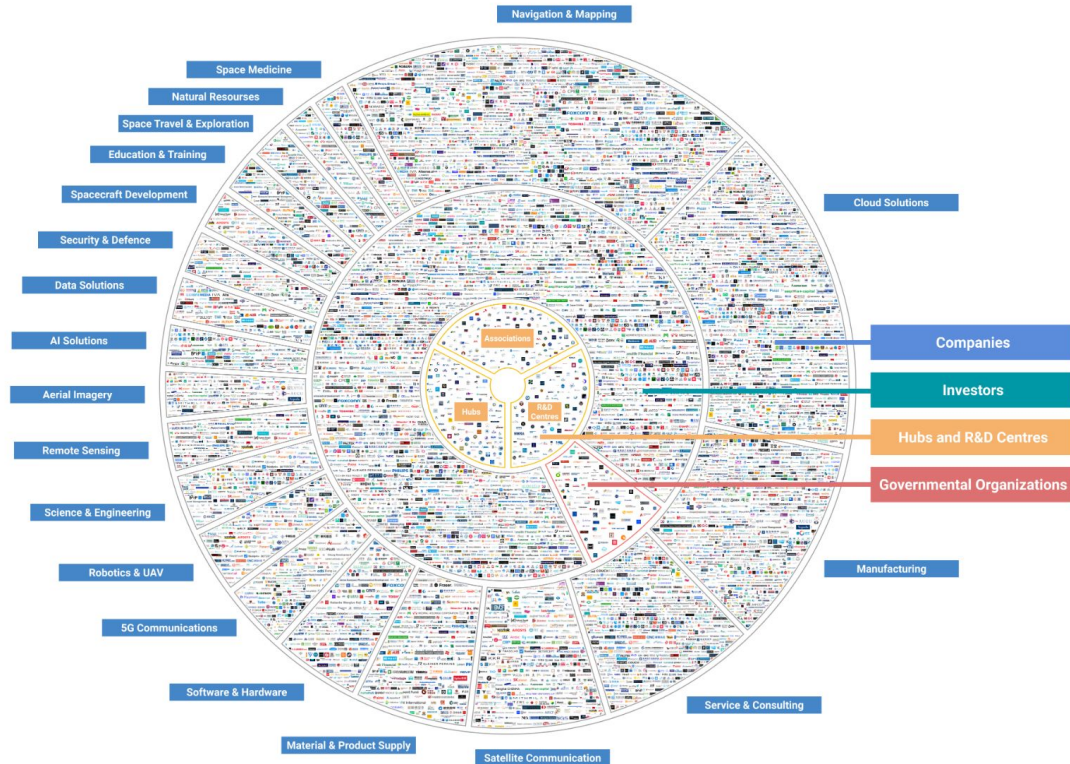
Global SpaceTech Ecosystem 2021

10 000 Companies

5 000 Investors

205 R&D Hubs and Associations

135 Government Organizations



USA

Canada

UK

Germany

China

France

India

Israel

Spain

Japan

Australia

CEE*

Singapore

France

Brazil

Ireland

Gulf Region

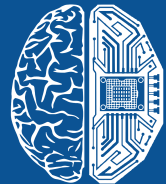
EU

* – Central and Eastern Europe

Government and Private Companies Cooperation

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Officials on Government Cooperation with Private Space Companies

Cooperation between governments and private companies is becoming ever-more important in the SpaceTech industry. Companies are increasingly looking to space as a place of business, and government space agencies all over the world have been changing in multiple ways, particularly by partnering with corporations to rapidly develop needed new technologies.



Jean-Jacques Dordain

Chancellor of the International Space University

"Alphasat is the fruit of a public private partnership between ESA and Inmarsat, an excellent example of how ESA is boosting Europe's competitiveness and growth."



Kathy Lueders

Associate Administrator of the Human Exploration and Operations Mission Directorate

"It's difficult to put into words how proud I am of the people who got us here today. I am simply amazed at what the NASA and SpaceX teams have accomplished together."



Charles F. Bolden

Former Head of NASA

"Turning over low-Earth orbit transportation to private industry will also allow NASA to focus on an even more ambitious mission: sending humans to Mars."



Jeffrey DeWit

CFO of NASA

"How you drive that is based on what we're doing now, which is trying to now prove the concepts and get the commercial sector involved. The only outcome for this is a positive, not only for NASA but for the space economy for private companies."

Boost and Support

Small businesses are vital to NASA's mission, helping expand humanity's presence in space and improve life on Earth. NASA has selected **365 U.S. small business** proposals for initial funding from the agency's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program, a total investment of **more than \$45M**.

19%

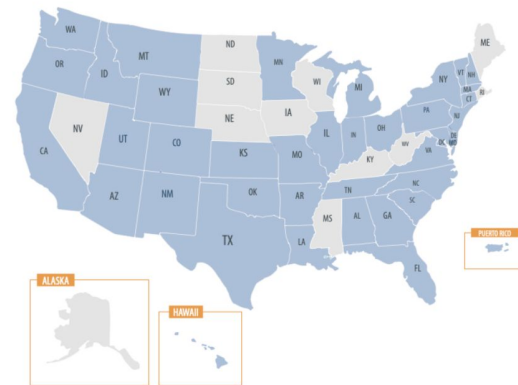
of the research institutions partnering with small business for STTR are classified as Minority Serving Institutions (MSIs)

Through the program, NASA works with U.S. small businesses and research institutions to advance cutting-edge technologies. The agency provides up to **\$125K** for companies to establish the merit and feasibility of their innovations. Phase I SBIR contracts are awarded to small businesses and last for six months, while Phase I STTR contracts are awarded to small businesses in partnership with a research institution and last for **13 months**. Based on their progress during Phase I, companies may submit proposals to subsequent SBIR/STTR opportunities and receive additional funding.

NASA Provides \$45 Million Boost to U.S. Small Businesses



289 small businesses and 47 research institutions across 38 states, D.C., and Puerto Rico selected to receive funding that supports technology development for NASA missions



91

companies selected for their first SBIR/STTR award

198

companies with previous awards selected

NASA

NASA is getting ready to send astronauts to explore more of the Moon as part of the Artemis program, and the agency has selected SpaceX to continue development of the first commercial human lander that will safely carry the next two American astronauts to the lunar surface. At least one of those astronauts will make history as the first woman on the Moon. Another goal of the Artemis program includes landing the first person of color on the lunar surface.

"With this award, NASA and our partners will complete the first crewed demonstration mission to the surface of the Moon in the 21st century as the agency takes a step forward for women's equality and long-term deep space exploration,"

said Kathy Lueders, NASA's associate administrator for Human Explorations and Operations Mission Directorate. "This critical step puts humanity on a path to sustainable lunar exploration and keeps our eyes on missions farther into the solar system, including Mars."

The firm-fixed price, milestone-based contract total award value is

\$2.89B



Illustration of SpaceX Starship human lander design that will carry the first NASA astronauts to the surface of the Moon under the Artemis program.



With the aim to commercialise the **KUBIK Incubator facility on ISS Columbus, ESA and Kayser Italia** signed the Bioreactor Express **commercial partnership in July 2019**. The KUBIK facility is suitable for a range of experiments in biology, biotech, human research, fluid physics, and materials science. It is equipped with a centrifuge and thermal control capability. The use of existing hardware such as experiment containers enable a competitive pricing and shorter lead times for commercial customers.



ESA and the County of Cornwall in the UK have partnered up to redevelop part of Goonhilly Earth Station, an existing commercial station in Cornwall, UK, to enable it to provide Europe's first deep-space tracking services on a commercial basis.

The Goonhilly project will be initially funded through a **€9.5M investment** from the UK's Cornwall & Isles of Scilly Local Enterprise Partnership.



Airbus Defence and Space partnered with ESA on **7 February 2018** to start developing a new commercial service for the International Space Station called Bartolomeo.

From early 2021, the versatile Bartolomeo 'All-in-one Mission Service' will provide end-to-end access for external payloads on the Station for many mission types at competitive prices.



The ICE Cubes service is the first European commercial opportunity to conduct research in space. This pioneering agreement signed between ESA and Space Applications Services NV/SA, Belgium, offers room to run experiments and conduct research in weightlessness inside ESA's Columbus laboratory on the International Space Station.

Launched in May 2018, the service provides rapid and simplified access to the station on a commercial basis.

ISRO tests satellites developed by private sector for the first time

Only recently has the Indian Space Research Organisation (ISRO) started to allow private space activity in India. Two satellites by Indian startups—**SpaceKidz India** and **Pixxel (incorporated as Sygyzy)**—were tested at the ISRO's UR Rao Satellite Centre of the in Bengaluru. This is a first for the space agency, which so far has only taken help in manufacturing and fabrication of various parts of satellites and rockets from the Indian industry. ISRO helped these two companies fix problems with the solar panels on their respective satellites.

Confirming the development, ISRO spokesperson **Vivek Singh** told HT that the two firms have finished the testing already. In the coming months, these two firms will also test their engines at Sriharikota spaceport and the Thiruvananthapuram rocket center.

"There have been several firms that have worked with ISRO in the past, but these firms are into manufacturing satellites. They are almost through with their development. In our next PSLV launch, they could be our co-passengers," he said.

A satellite designed by students from **SpaceKidz India** had been launched by ISRO as an experiment in **January 2019** using the fourth stage of the PSLV—which usually goes to waste—as the platform for the KalamSat.

Another startup, **Skyroot** is working toward developing a launch vehicle that is likely to be launched by the end of the year. ISRO will share their spaceports—the existing one at Sriharikota and the upcoming one in Thoothukudi—with industries for such missions.

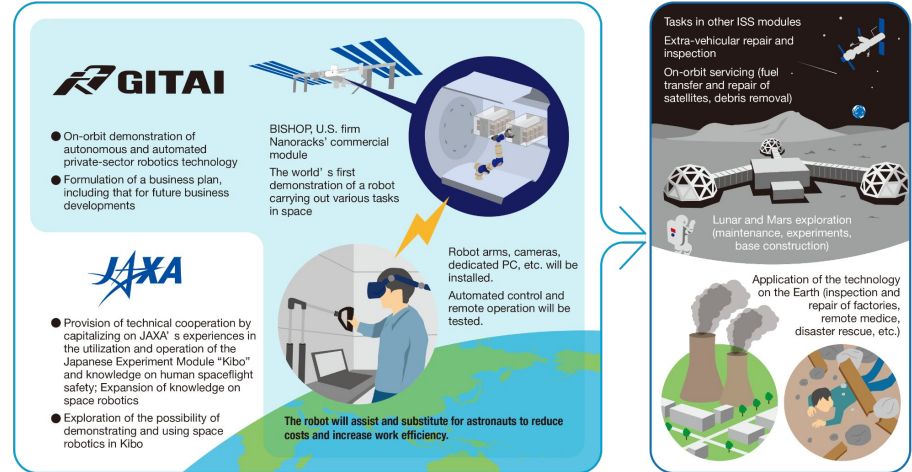


GITAI and JAXA to Embark on the Co-creation of World's First Space Robot Business

GITAI Japan and the Japan Aerospace Exploration Agency (JAXA) will co-create a new business concept for the robotization of work in space as a project of the JAXA Space Innovation through Partnership and Co-creation (J-SPARC) initiative*2. Under this project, the organizations aim to identify tasks in space that require robotization, develop robotics technologies that will carry out the tasks, and provide services using robots.



Technology demonstration of GITAI's robot in the ISS BISHOP Airlock Module (mock-up) built at GITAI Tokyo office.

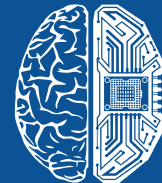


GITAI will, for the first time as a private-sector company in the world, perform a technology demonstration of its robots designed for the autonomous control and automation of the processing of specific tasks. JAXA will support GITAI's activities through technical cooperation while also aiming to expand its knowledge on space robotics through this project. GITAI and JAXA will also explore new services based on space robotics that can be provided for the International Space Station (ISS) and other future missions.

Comparative Matrix of Countries Space Activity

July 2021

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R&D Hubs, Associations and Government Organizations

Government Organizations - 136
R&D Centres - 132
Associations - 53
Hubs - 19

Associations

Hubs

Government Organizations

R&D Centres



Methodology

The analysis includes the fifty largest national Space Agencies selected by budget size. They were compared by sixteen indicators of space activity. All the indicators are equally weighted at 1 point each, so the general score ranges from 0 to 16. Generally, the indicators belong to 2 groups: capabilities and goals.

Content

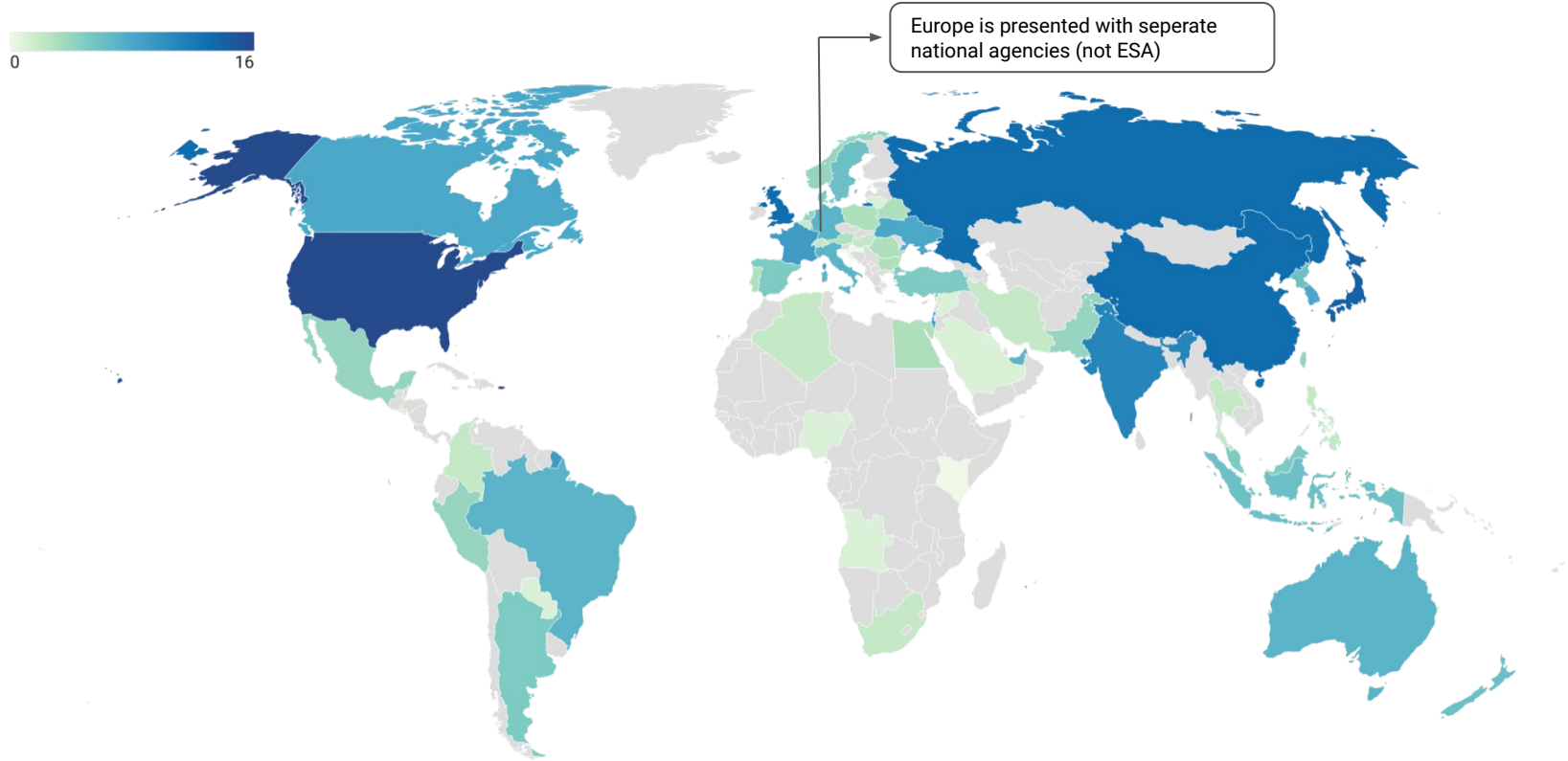
The general analysis begins with defining sixteen core indicators of each country's space activity. Based on that analysis, the "heat" map countries differing by space activity was created. The next slides represent the matrices of the space activity, including detailed information per country. The first five matrices include information about the country's goals and commitments, with the following five about the capabilities.

Some findings

The US is clearly the most active on the map (with all sixteen points). However, the spread of space activity on the African continent is less expected. The activity of the countries of Oceania is also noticeable.

The trend is justified, as space technology can bring many benefits to the economy or nature of countries. However, more and more countries growing clearly interested in engaging in more ambitious areas like space mining or Mars settlement.

Space Activity by Country



The countries were rated by the number of Space Activity Indicators. Basically, there are sixteen indicators described on the next page. In recent years, with reducing costs, space activity among African countries has been growing significantly.

Indicators of Space Activity

1	Astronauts	Has trained astronauts able to participate in space missions	10	Liquid rocket engines	Has the ability to develop and deploy engines
2	Satellites	Operates own satellites at the orbit	11	Space probes	Has the ability to operate probes
3	Sounding rockets	Can build and use sounding rockets	12	Human spaceflight	Has the ability and corresponding technologies to send people to space and keep them alive
4	Outer Space Treaty	Acceded to the Treaty	13	Space mining	Have established a goal to develop space mining technologies and perform research on it
5	Moon Agreement	Acceded to the Treaty	14	Mars Program	Have established the goal of Mars exploration or settlement, and sent or plan to send missions to Mars
6	Artemis Accords	Acceded to the Artemis Accords (Moon exploration program)	15	Moon Program	Have established the goal of Moon exploration or settlement, and sent or plan to send missions to Moon
7	National legislation on space-resource utilization	Passed the legislation	16	Space Medicine	Researches and develops Space Medicine techniques
8	Spaceport(s)	Has spaceport(s) with launch capabilities			
9	Orbital payload	Can deliver payload to orbit			

Plunge of the Cost of Space Activities will Make Smaller Nations More Ambitious

Country	Acceded to Outer Space Treaty	Acceded to Moon Agreement	Acceded to Artemis Accords	Passed National Legislation on Space-Resource Utilization	Space Mining Activity	Mars Program	Moon Program
USA	+	-	+	+	+	+	+
China	-	-	-	+	+	+	+
EU	-	-	-		+	+	+
UAE	-	-	+	+	+	+	+
Germany	+	-	-	-	+	-	-
France	+	-	-	-	-	-	-
Russia	+	-	-	+	+	+	+
India	+	-	-	-	-	+	+
Japan	+	-	+	+	+	+	+
Saudi Arabia	-	-	-	-	-	-	-

Plunge of the Cost of Space Activities will Make Smaller Nations More Ambitious

Country	Acceded to Outer Space Treaty	Acceded to Moon Agreement	Acceded to Artemis Accords	Passed National Legislation on Space-Resource Utilization	Space Mining Activity	Mars Program	Moon Program
Italy	+	-	+	-	-	-	+
South Korea	-	-	+	-	-	-	+
UK	+	-	+	+	+	+	+
Algeria	-	-	-	-	-	-	-
Canada	+	-	+	+	-	-	+
Belgium	+	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-
Switzerland	+	-	-	+	-	-	-
Luxembourg	+	-	+	+	+	-	+
Netherlands	+	+	-	-	-	-	-

Plunge of the Cost of Space Activities will Make Smaller Nations More Ambitious

Country	Acceded to Outer Space Treaty	Acceded to Moon Agreement	Acceded to Artemis Accords	Passed National Legislation on Space-Resource Utilization	Space Mining Activity	Mars Program	Moon Program
Sweden	+	-	-	-	-	-	-
Norway	+	-	-	-	-	-	-
Taiwan	-	-	-	-	-	-	-
Ukraine	+	-	+	-	-	-	+
Austria	+	+	-	-	-	-	-
Poland	+	-	-	-	-	-	-
South Africa	+	-	-	+	-	-	-
Indonesia	+	-	-	-	-	-	-
Brazil	+	-	+	-	-	-	-
Argentina	+	-	-	-	-	-	-

Plunge of the Cost of Space Activities will Make Smaller Nations More Ambitious

Country	Acceded to Outer Space Treaty	Acceded to Moon Agreement	Acceded to Artemis Accords	Passed National Legislation on Space-Resource Utilization	Space Mining Activity	Mars Program	Moon Program
Pakistan	+	-	-	-	-	-	-
Egypt	+	-	-	-	-	-	-
Angola	-	-	-	-	-	-	-
Croatia	-	-	-	-	-	-	-
Israel	-	-	-	-	-	-	-
Australia	+	-	-	-	+	-	+
Portugal	+	-	+	-	+	+	+
Nigeria	-	-	-	-	+	-	-
Mexico	-	-	-	-	-	-	-
Iran	+	-	-	-	-	-	-

Plunge of the Cost of Space Activities will Make Smaller Nations More Ambitious

Country	Acceded to Outer Space Treaty	Acceded to Moon Agreement	Acceded to Artemis Accords	Passed National Legislation on Space-Resource Utilization	Space Mining Activity	Mars Program	Moon Program
Romania	-	-	-	-	-	-	-
Philippines	+	-	-	-	-	-	-
Turkey	-	+	-	-	-	-	-
New Zealand	+	-	+	-	-	-	+
Kenya	-	-	-	-	+	-	-
Bulgaria	+	-	-	-	-	-	-
Colombia	-	-	-	-	-	-	-
Denmark	+	-	-	-	-	-	-
El Salvador	+	-	-	-	-	-	-
Hungary	+	-	-	-	-	-	-

Current Capabilities of Government Agencies are Small, but will Grow Rapidly

Country	Astronauts	Operates Satellites	Have Spaceport(s)	Sounding Rocket Capability	Orbital Payload Capability	Ability to Develop and Deploy Liquid Rocket Engines	Ability to Operate Space Probes	Human Spaceflight Capability
USA	+	+	+	+	+	+	+	+
China	+	+	+	+	+	+	+	+
EU	+	+	+	+	+	+	+	+
UAE	+	+	-	-	-	-	+	-
Germany	+	+	-	+	-	+	-	-
France	+	+	+	+	+	+	+	-
Russia	+	+	+	+	+	+	+	+
India	+	+	+	+	+	+	+	-
Japan	+	+	+	+	+	+	+	-
Saudi Arabia	-	+	-	-	-	-	-	-

Current Capabilities of Government Agencies are Small, but will Grow Rapidly

Country	Astronauts	Operates Satellites	Have Spaceport(s)	Sounding Rocket Capability	Orbital Payload Capability	Ability to Develop and Deploy Liquid Rocket Engines	Ability to Operate Space Probes	Human Spaceflight Capability
Italy	+	-	+	+	-	+	-	-
South Korea	+	+	+	+	+	+	-	-
UK	+	+	+	+	+	+	-	-
Algeria	-	+	-	+	-	-	-	-
Canada	+	+	-	+	-	-	-	-
Belgium	+	-	-	-	-	-	-	-
Spain	+	+	+	+	-	+	-	-
Switzerland	-	-	-	+	-	-	-	-
Luxembourg	-	-	-	-	-	-	-	-
Netherlands	+	+	-	+	-	-	-	-

Current Capabilities of Government Agencies are Small, but will Grow Rapidly

Country	Astronauts	Operates Satellites	Have Spaceport(s)	Sounding Rocket Capability	Orbital Payload Capability	Ability to Develop and Deploy Liquid Rocket Engines	Ability to Operate Space Probes	Human Spaceflight Capability
Sweden	+	+	+	+	-	+	-	-
Norway	-	+	+	+	-	-	-	-
Taiwan	-	+	+	+	+	-	-	-
Ukraine	+	+	-	+	+	+	-	-
Austria	+	-	-	-	-	-	-	-
Poland	+	+	-	+	-	-	-	-
South Africa	-	-	-	-	-	-	-	-
Indonesia	+	+	+	+	-	-	-	-
Brazil	+	+	+	+	-	+	-	-
Argentina	-	+	+	+	-	-	-	-

Current Capabilities of Government Agencies are Small, but will Grow Rapidly

Country	Astronauts	Operates Satellites	Have Spaceport(s)	Sounding Rocket Capability	Orbital Payload Capability	Ability to Develop and Deploy Liquid Rocket Engines	Ability to Operate Space Probes	Human Spaceflight Capability
Pakistan	-	+	+	+	-	-	-	-
Egypt	-	+	+	+	-	-	-	-
Angola	-	+	-	-	-	-	-	-
Croatia	-	-	-	-	-	-	-	-
Israel	+	+	+	+	+	-	-	-
Australia	-	-	+	+	-	-	-	-
Portugal	-	-	+	-	-	-	-	-
Nigeria	-	+	-	-	-	-	-	-
Mexico	+	+	-	+	-	-	-	-
Iran	-	-	+	+	+	-	-	-

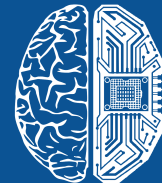
Current Capabilities of Government Agencies are Small, but will Grow Rapidly

Country	Astronauts	Operates Satellites	Have Spaceport(s)	Sounding Rocket Capability	Orbital Payload Capability	Ability to Develop and Deploy Liquid Rocket Engines	Ability to Operate Space Probes	Human Spaceflight Capability
Romania	+	+	-	-	-	-	-	-
Philippines	-	+	-	-	-	-	-	-
Turkey	-	+	-	+	-	+	-	-
New Zealand	-	+	+	+	+	-	-	-
Kenya	-	+	-	-	-	-	-	-
Bulgaria	+	+	-	-	-	-	-	-
Colombia	-	+	-	-	-	-	-	-
Denmark	-	+	+	-	-	+	-	-
El Salvador	+	+	-	-	-	-	-	-
Hungary	-	+	-	-	-	-	-	-

Most Advanced Government Space Agencies

July 2021

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Government Agencies (According to Number of Employees*)

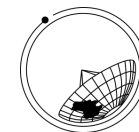
1-100



100-1000

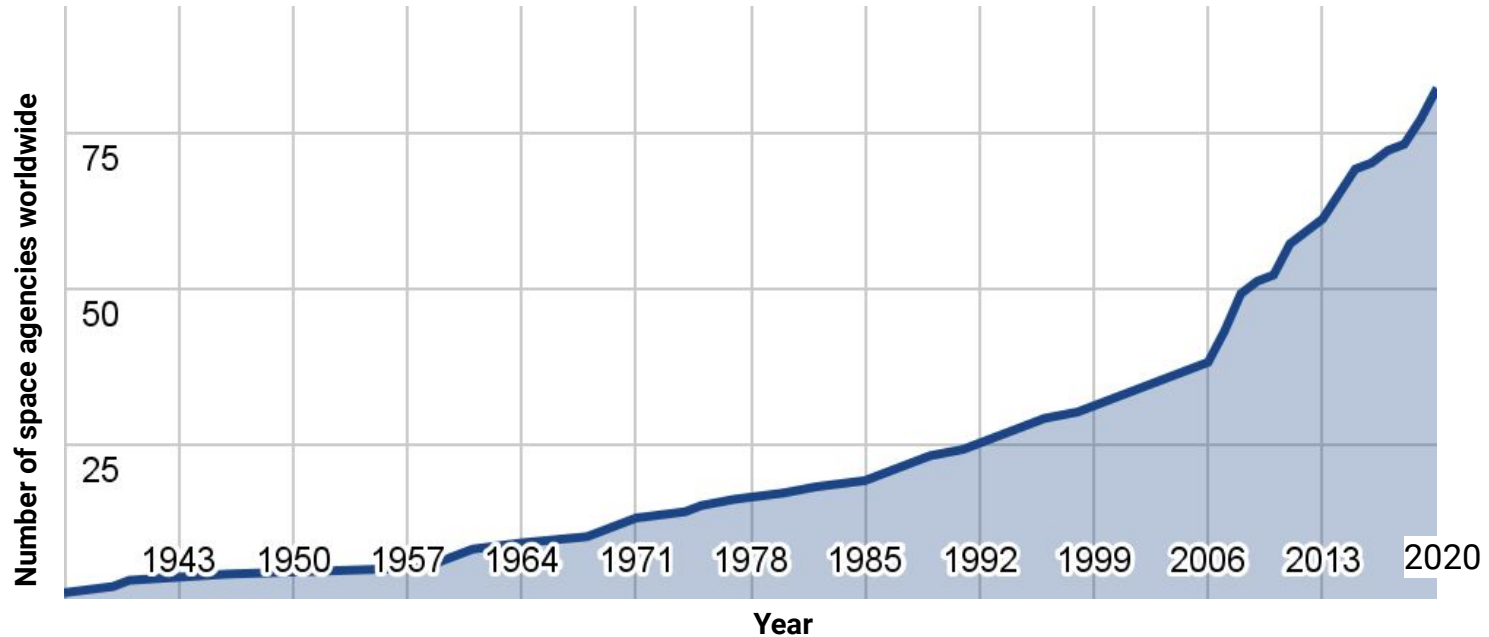


>1000



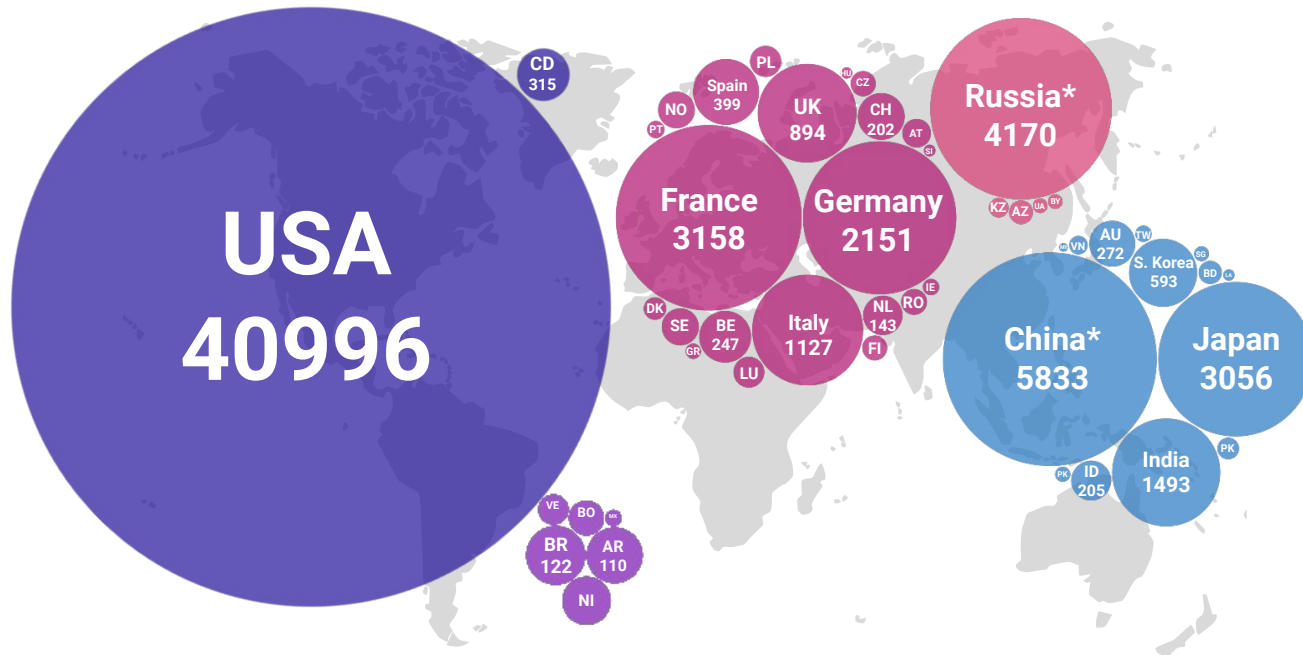
* Those agencies for which the numbers of employees could not be readily determined are not represented here.

Government Space Agencies Timeline 2021



To date, more than seventy countries have established state-funded agencies to facilitate space exploration and research, the deployment of artificial satellites, and the development of space resources. In addition, several groups of countries have pooled their resources to establish regional agencies for the same purposes. Only a small number of these national and regional space agencies are capable of launching satellites and vehicles into space. Even fewer have human spaceflight and lunar or Mars landing capabilities. The timeline about space agencies emergence is based on open sources data and performed as a progression graph.

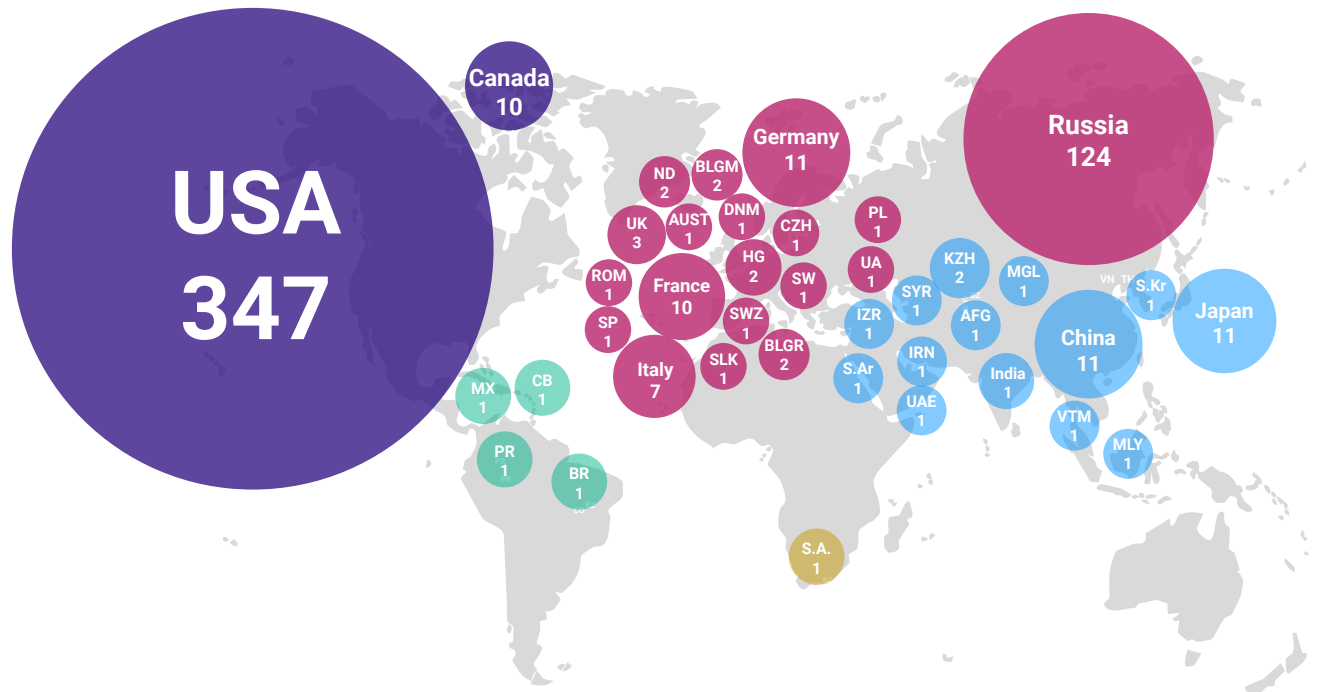
NASA and the DOD Dominate World Space Spending



The United States spends more on space than all other countries combined. Its budget for its space activities exceeds those of China, Russia, France, Japan, and Germany by a wide margin. In 2018, of \$70.9 billion government space investments, 63% were spent on civil programs, as military budgets tend to fluctuate on lengthier budget cycles. World space budgets are projected to continue their growth trend, with no reason to expect a downturn.

*Note that information about the budgetary spending on space of China and Russia is collected from publicly available sources, but due to the policies and lack of standard bookkeeping of these countries, it may not be fully disclosed or even known to themselves.

USA Dominates Even Russia in Number of Astronaut Flights



There are forty-one countries represented here. The analysis relies on the World Air Sports Federation (FAI) definition of outer space beginning at 100* kilometers altitude. Those who have traveled above an altitude of 80 kilometers (50 miles) are awarded “astronaut wings” in the USA. The data is provided by the International Astronaut Database.

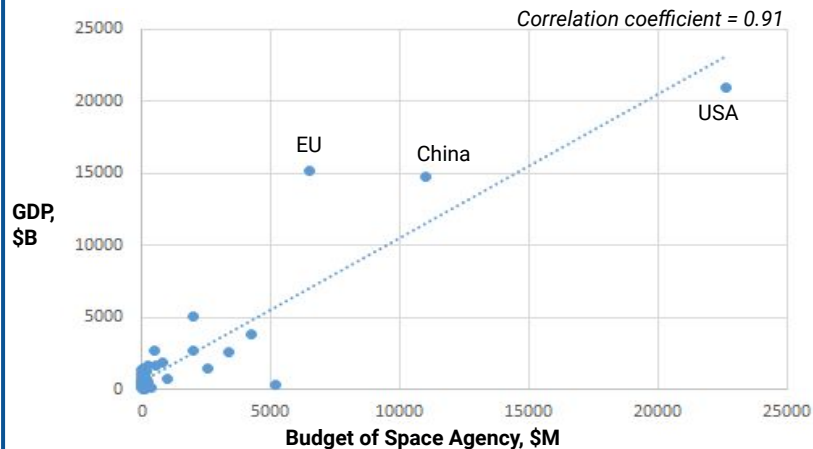
*Recent analysis at Harvard indicates that 80 km is probably a better physical number than 100 km, and FAI may change their own criteria.

GDP and Government Space Spending Show Positive Correlation

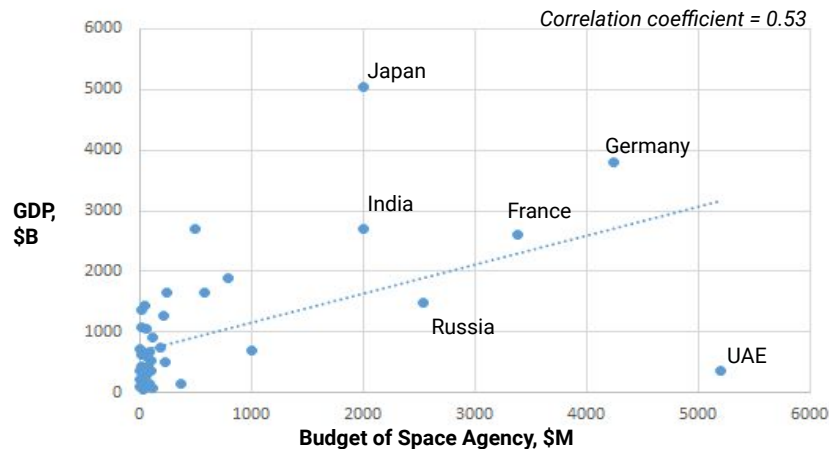
The linear model demonstrates a strong pattern of correlation. The trend is apparent: the higher the GDP, the larger the space agency budget. However, Japan and the UAE are outliers of pattern violation.

The major space players set the trend. **China** seems to challenge the **USA**, while the **EU** seems to be less enthusiastic about the race. However, the scale of these three players somewhat distorts the overall picture, as the other players look relatively small.

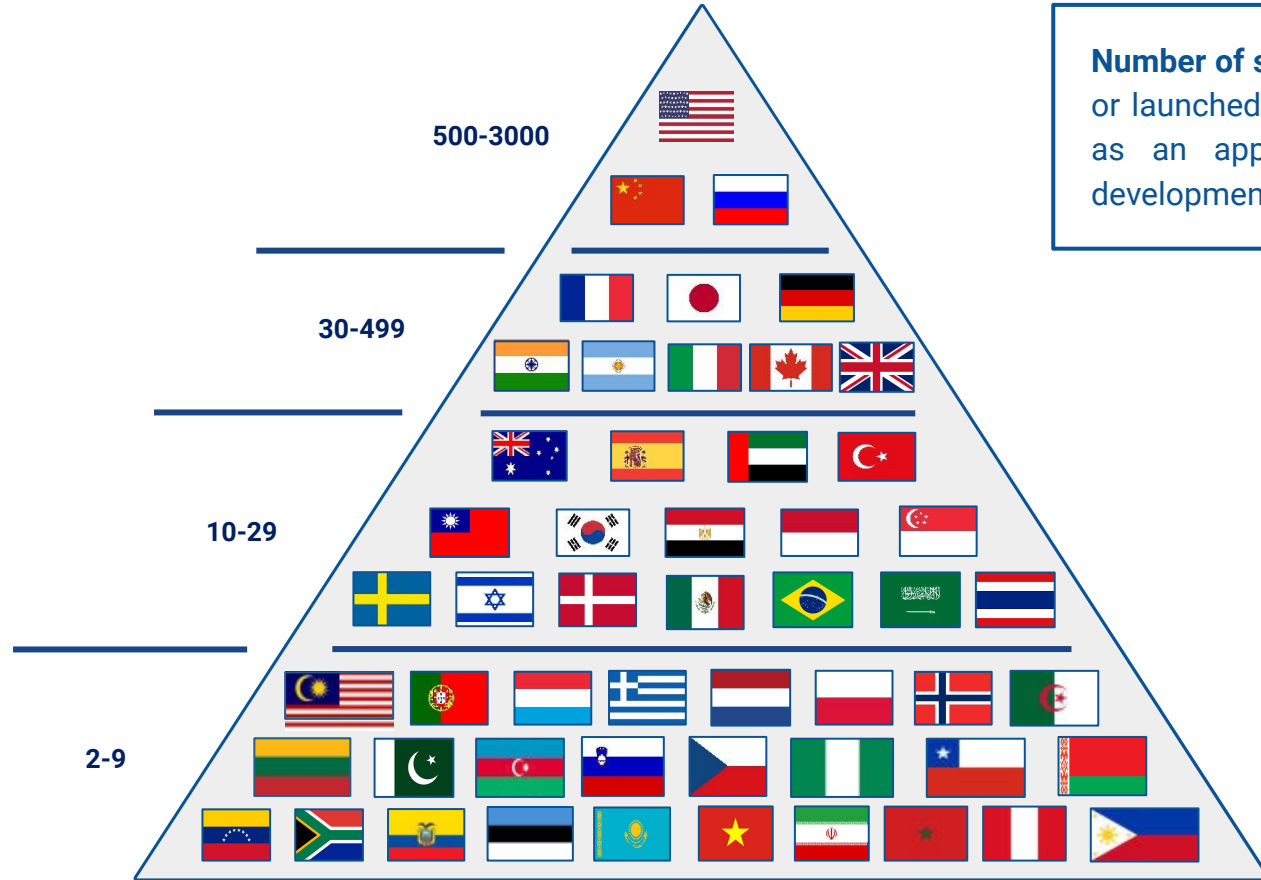
** EU is represented by the European Space Agency*



This graph includes forty-three countries and the outliers were excluded (USA, EU, China). The positive trend is still observable, though the scatter of values looks larger. This means that the policies and priorities of states play an important role. **The UAE** spends a notably disproportionate amount on space. **Russia** also outspends with regard to its GDP. Conversely, despite a large GDP, **Japan** spends relatively less money on space than the others.



USA, Russia, and China Lead in Satellites Launched

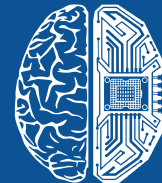


Number of satellites either owned or launched by country used here as an approximate SpaceTech development

New Space Nations: Activity Overview

July 2021

www.spacetech.global



**SpaceTech
Analytics**

SpaceTech Analytics

36

The Space Industry is Gaining Momentum





























Becoming a hot topic, as well as a necessity, dozens of countries worldwide are beginning to develop national space industries. Some countries stand out among others in this trend. They are called New Space Nations and the following slides include analysis of seven such nations: Australia, New Zealand, Argentina, South Korea, Luxembourg, the Isle of Man and the United Arab Emirates.



Each country differs by these main four parameters

Model	<p>Hub: a country attracts space organizations, providing favorable business environment, accessible investment funds, simplified regulation, lower taxation, etc.</p> <p>Production: a country founds state companies, develops manufacturing and R&D capacities; state organizations play a crucial role in space industry</p>	➡
Ambitions	Regarding space exploration some countries are aimed solely at researching practical things to improve the country's socio-economic performance. Others are ready to invest in deep-space activities with unknown and potentially illusory achievements in the distant future (e.g. Mars settlement).	➡
Applications	In search of economic benefit, prestige, or technology maturation, countries develop their space industry. For the most part, this is for the peaceful use of technology, but in some cases military applications are important as well.	➡
Budget	The budget of each country differs according to the wealth of the nation and the three parameters above. The UAE is an example of a country with great ambitions and considerable wealth (\$ 5 B space budget).	➡

Comparison tables

Hub		Production					
  		   					
Earth		Earth & Near Space		Earth & Deep Space			
		  		  			
Peaceful		Military		Both			
    				 			
MIN		< \$500M >				MAX	
\$3.8M     						  \$5B	

UAE Has Made Rapid Progress

The UAE is an ambitious country that has already become a regional leader and a respected international partner. Wanting to diversify from oil, the space sector is recognized as an integral part of their knowledge-based economy. Nowadays, the UAE has well-developed satellite building, data processing, and all other related technologies, and is already capable doing deep-space missions, as demonstrated by its recent Mars orbiter.

Space exploration projects

Emirates
Mars
Mission

UAE aims to establish a settlement on Mars by 2117

Emirates
Lunar
Mission

It seeks to explore neglected regions of the Moon

AE
Astronaut
Programme

It trains Emirati astronauts for specialist work in space missions

Earth-related projects

Global
Navigation
Satellite
Systems



Applications

- Autonomous vehicles
- Drones (UAV)
- Precision farming
- Accurate navigation in urban canyons
- GNSS cybersecurity

Arab
Satellite 813
cooperative
project of Arab
countries



Applications

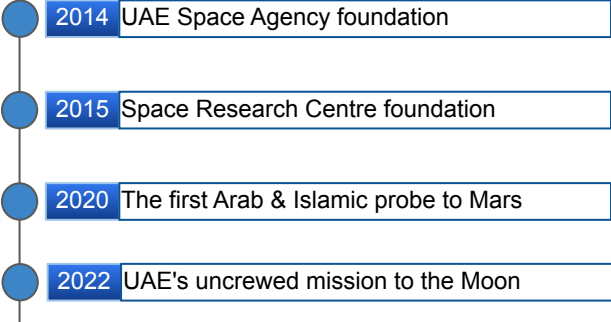
- Environmental mapping and monitoring
- identifying natural resources
- Land cover dynamics
- Crop and mining site conditions
- Internal water quality and spread
- Land erosion and soil pollution versus climate

UAE Space Agency



Main responsibilities: establishing partnerships, assisting academic programs, advancing national and regional space exploration, and investing in research, development and commercial space projects.

Budget In 2021 \$ 5 000 000 000



Scientific Hubs and Centers



Mohammed bin Rashid Space Center (MBRSC)

Type: Scientific hub

Category: Research, exploration, satellites and space systems development

Description: It is a technological hub which provides scientific research and exploration, satellites and space systems development, satellite imagery, ground station services, observation, and remote sensing. The hub oversees the 2017 National Space Programme, particularly the UAE Astronaut Programme, the Mars 2117 Strategy, which aims to build a city on Mars by 2117.



Space Reconnaissance Center (SRC)

Type: Scientific hub

Category: Satellite imagery

Description: SRC is a high-end technological center for receiving, processing satellite imagery data and information exploitation that assist in early warning, monitoring, and planning security missions of the UAE Armed Forces. The received data comes either from satellite constellations such as IKONOS (USA), IRS (India), and KOMPSAT (Korea), or aerial platforms like aircrafts. The SRC operates the Falcon Eye satellite additionally.

Academia



Sharjah Academy for Astronomy, Space Sciences and Technology (SAAST)

Type: Research laboratories

Category: Research, exploration

Description: It is continuously working on expanding its research laboratories to ensure that it is a vital and effective contributor to the development of the Astronomy, Space sciences & Technology field as well as the space sector. The Academy operates the UAE Meteor Monitoring Network project funded by the UAE Space Agency to monitor the sky for any type of space debris whether it is human-made like satellites or meteors and fireballs.

UAE – Companies and R&D Centers Subordinated to National Space Agency

Research Centers and Academia



National Space Science and Technology Center (NSSTC)

Type: Scientific hub

Category: Research, exploration, development

Description: It is an incubator for space research and innovation, finds its origin in a tripartite initiative involving the UAE University, the UAE Space Agency, and the Telecommunication Regulatory Authority (ICT-Fund). The NSSTC is conducting research projects such as Design, Development, and Analysis of 3U CubeSats; Frequency-Agile Space Radio; Earth and Mars Atmospheric Studies; and Emirates Mars Mission Graduation Projects.



Yahsat Space Laboratory (YSL)

Type: Scientific hub

Category: Research, education, satellite design and manufacturing

Description: It aims to develop technologies within the space sector. YSL was launched by Khalifa University, Al Yahsat Satellite Communications Company, and Orbital ATK. The lab provides students of the Khalifa University with the facilities required to construct, test and launch miniature satellite CubeSats. In 2020, YSL, Khalifa University of Science and Technology, and the UAE Space Agency, established the Khalifa University Space Technology and Innovation Centre (KUSTIC).



Assembly, Integration, and Testing (AIT) Satellite Center

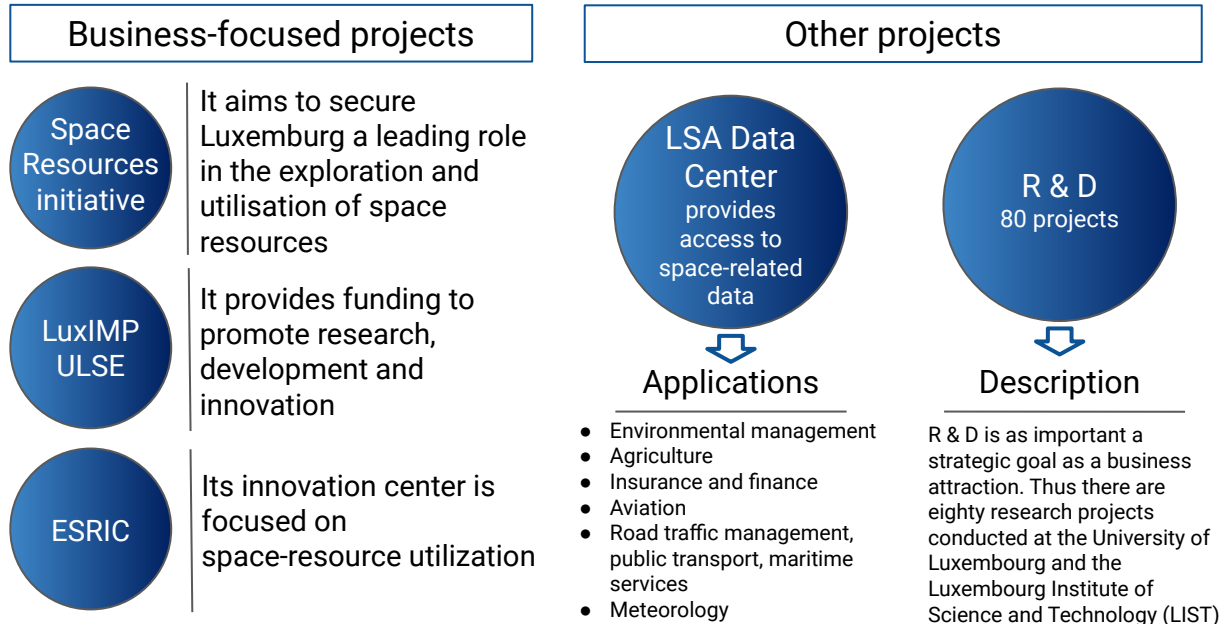
Type: Scientific hub

Category: Satellite manufacturing

Description: It is under construction by Tawazun Economic Council (a defence and security entity in the UAE), Airbus and NSSTC. The Center aims to manufacture components and assemble, integrate, and test small to medium communications, navigation, and hyperspectral satellites. The first satellite will be launched in 2021 and the second will be launched in 2022. Located in Al Ain, it will also provide training opportunities at Airbus facilities in France.

Luxembourg – New Space Hub

Luxembourg has ambitions to become Europe's commercial space hub. It actively develops space business activities and invests millions in space technology start-ups. It has been already implemented one the most space-friendly law systems worldwide and has over fifty space companies based there. It wants to diversify from steel, and have the space industry drive prosperity. This can be achieved through fostering research, innovation, new developments and more. In particular, the country is betting heavily on a breakthrough in asteroid mining. Even today, the space and satellite sectors reach almost 2% of its GDP.



Luxembourg Space Agency



The Agency is focused on business development and the creation of economic value and jobs through the development of the space sector. It works through investments and business attraction rather than direct research and space missions.

**Budget
In 2021**

\$ 130 000 000



Research & Development Centers and Academia



Luxembourg Institute of Science and Technology (LIST)

Type: Scientific hub

Category: Research, exploration, technologies' development

Description: It is one of the leading mission-driven research and technology organisation. The institute provides a whole series of applied research projects with the aim of improving materials used in the space in terms of functionality, lightness or durability. It offers a whole series of materials characterisation and testing services and develops new services based on satellite data. LIST is a member of the Luxembourg Space Cluster.



European Space Resources Innovation Center (ESRIC)

Type: Innovation center

Category: Space resources utilization

Description: It is an innovation centre exclusively focused on space resources utilization. ESRIC aims to become the internationally recognised centre of expertise for scientific, technical, business and economic aspects related to the use of space resources for human and robotic exploration, as well as for a future in-space economy. It is a joint initiative of the Luxembourg Space Agency (LSA), Luxembourg Institute of Science and Technology (LIST), and the European Space Agency (ESA).



University of Luxembourg

Type: University

Category: Education

Description:

Together with the Luxembourg Space Agency, the university offers a unique master's programme: Interdisciplinary Space Master (ISM). ISM students are able to design their own CubeSat mission. ISM students are connected to Platzer, whose sa

Isle of Man – the Space Island

Similar to Luxembourg, the Isle of Man aspires to be a commercial space hub. Although it is an internally self-governing dependent territory of the British Crown, the Isle of Man acts independently in these issues. It develops a space business-friendly environment attracting multiple for-profit and non-profit organizations to the island. In 2010, twelve space companies located there, generating nearly \$553 million. It was predicted to become the fifth country in the world to get a person to the moon, but this hasn't happened yet. Nonetheless, the Isle of Man continues to develop its space industry. Besides a number of companies, three major non-profit organizations are based here: Space Data Association, Satellite Interference Reduction Group, and ISU's International Institute of Space Commerce

Isle of Man – Companies and R&D Centers

Spacelsle

WWW
SPACEISLE.COM
THE ISLE OF MAN IN SPACE

Spacelsle is a business-oriented cooperative resource. However, the main actor is the local government itself, by fostering a pro-space jurisdiction and simple regulation to develop the space industry. One of the main advantages is the absence of insurance-premium tax.



INTERNATIONAL INSTITUTE
OF SPACE COMMERCE

International Institute of SpaceCommerce

Type: Non-partisan think tank

Category: Exchanging, discussing, and creating new ideas in space commerce.

Description: The Institute's mission is to become the leading think-tank in the study of the economics of space. It is intended to be the intellectual home for the Industry and Space Academia around the world for which it shall perform studies, evaluations and provide services to all interested parties with the ultimate aim to promote and enhance world's space commerce to the general public.



ManSat

Type: Private Company

Category: Satellite communication, supplying satellite space for GPS satellites.

Description: ManSat satellite spectrum filing service provides confidential, reliable, and cost-effective access to the ITU via the Isle of Man. Its spectrum currently provides Internet, Earth observation, remote sensing, and many other services to more than a billion people worldwide. ManSat also helping the Isle of Man government to prepare its orbital filings to the International Telecommunications Union, the Geneva-based UN agency.

South Korea – Economy, Prestige, and Defence

South Korea began to actively develop its space sector in the mid-2000s. The threat from North Korea is one of the main drivers to develop space technologies (navigation, reconnaissance, solid-fuel rockets, etc). Moreover, South Korea has joined the space race and has corresponding ambitions with plans of space exploration, participating in multiple international projects (such as Moon Program Artemis).

Space exploration projects

Korean Lunar Exploration Program

It aims to develop Korea's space technology capacity and increase both the national brand value and national pride

Korean Space Launch Vehicle

The goal is to provide Korea with full autonomous launch capabilities

Solid-Fuel Propellants

One-more stage to ensure military missile capability and further develop space exploration capabilities

Earth-related projects

Korea Positioning System
is a GPS center on the Korean peninsula



Applications

- Ultra-precision location data service
- National network independence of foreign systems
- Self-driving automobiles
- Drone industry

National Satellite Operation & Application Center



Applications

- Meteorology
- Environmental mapping and monitoring
- Road traffic management, public transport, maritime services
- adjustment and management of orbit
- Other public and private sectors

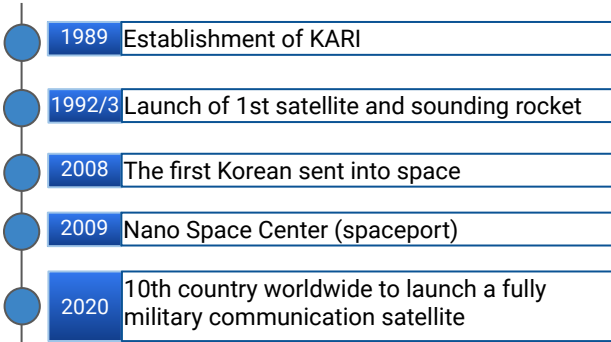
Korea Aerospace Research Institute (KARI)



Kari is a core Korean aeronautics and space agency that develop space technologies and provides national safety and public service in corresponding sectors. It leads all main Korean space projects from the Korea Positioning System to the Korean Lunar Exploration Program

Budget in 2021

\$ 553 100 000



South Korea – Companies and R&D Centers Subordinated to Korea Aerospace Research Institute

National scientific Hubs and Agencies



Korea Astronomy & Space Science Institute (KASI)

Type: Scientific hub

Category: Research, exploration, development

Description: KASI conducts research activities on optical, radio, theoretical astronomy, space science, in particular, by developing, establishing, operating medium- and large-sized observational facilities and instruments. It's acquired the core technologies needed to develop space-surveillance capabilities through the establishment of the OWL-Net optical space-surveillance program, in order to build a radar-surveillance system for SSA.



국 방 과 학 연 구 소
Agency for Defense Development

Agency for Defence Development (ADD)

Type: Scientific hub

Category: Research and development of defense technologies

Description: It is the national agency for research and development of defence technologies, including space-related technologies. It supports the improvement of the national defense industry through research, development, and testing of weapons and equipment. ADD conducts R&D activities in such areas as space-based surveillance and reconnaissance System, small satellite system, and military communication systems

Academia



Korea Advanced Institute of Science and Technology (KAIST)

Type: Research laboratories

Category: Research, education

Description: It houses many specialized centres such as the Microsatellite Constellation Research Center, the Radiation and Nuclear Engineering Research Centre, the Combustion Engineering Research Center, the Satellite Technology Research Center, the MARS AI Research Center, and the Perigee-KAIST Rocket Research Center. I-Space research center by KAIST develops a system that tracks/identifies objects in outer space with research related to space systems.

Research Centers and Academia



The Korea Institute of Geoscience and Mineral Resources (KIGAM)

Type: Research institute of geoscience

Category: Research of the surface of planetary bodies

Description: It contributes to space exploration by investigating the surface of planetary bodies. The institute has expanded its research into several space fields such as planetary geology, GIS mapping, RS payload development, geophysical exploration, electronics, resource extraction, and resources utilisation. One of its current focuses is on lunar science and exploration.



Electronics and Telecommunications Research Institute (ETRI)

Type: Scientific hub

Category: Development of telecommunication technologies

Description: It develops and distributes technologies in information, electronics, communications, broadcasting, and convergence technologies. The institute hosts the Telecommunication & Media Research Laboratory, which is working on developing network technologies and 5G mobile communication, or radio-satellite research.



Korea Aerospace University (KAU)

Type: Scientific hub

Category: Research, education

Description: KAU is an educational institution for those who want to work in the aerospace industry. As a part of KAU, the Research Center for Aerospace Components Development conducts research work related to the components technology of aerospace industries under the sponsorship of the Department of Industry, Kyonggi-do Provincial Government. It covers aircraft structural mechanics, aerodynamics and flight mechanics, aircraft power plants, and control engineering.

Argentina – to Develop Citizen Oriented Space Industry

Argentina is a country with a long space history dating back to the 1950s, but it was interrupted by the geopolitical situation (the U.S. insisted on terminating further R&D). In the 2000s, a new space history of Argentina begins but with priority on civilian objectives. Today, it is one of few high-tech well-developed Argentinian sectors that is also an economy and innovation driver. Thus, it has become a strategic direction for a country with plans to gain socio-economic benefits from space in the long run.

Space exploration projects

ARSAT

Provides telecommunication services for Argentina and neighboring countries. Another 200,000 houses in rural areas are expected to be connected

Launch Vehicle

Argentina develops full autonomous launch capabilities (orbital and suborbital launchers (up to 1T payload capacity)

Exploration & Peaceful Use of Space

Long-term objective to become capable of interplanetary missions and participation in deep-space activities.

Earth-related projects

SAOCOM
the Argentinian
microwave Earth
observation
satellite



Applications

- Integrated Soil Moisture Maps
- Environmental mapping, monitoring, and risk analyzing
- monitoring public works, crops, forest and marine resources
- judicial and insurance activities
- topography

Healthcare
using space-data



Applications

- To provide citizens with information on health issues through CONAE's Geoportal
- Special courses on the use of EO data to monitor diseases, create risk maps, etc.
- Analysis of the relationship between the environment and the emergence of diseases

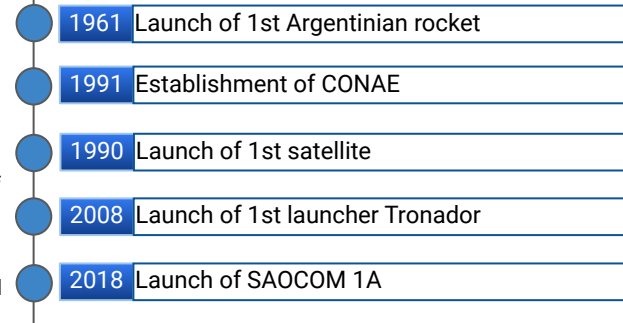
Argentina National Space Activities Commission (CONAE)



The commission coordinates national space activities and implements the National Space Plan. Its goal is to guide the space industry with civilian purposes and develop international cooperation. The main challenges are funding disruptions.

**Budget
in 2019**

\$ 45 300 000



Argentina – Companies and R&D Centers Subordinated to National Space Agency

Government Company



ARSAT

Type: Government-owned Company

Category: Satellite telecommunications, fiber-optic communication, digital television infrastructure, mobile phone infrastructure.

Description: ARSAT is the national telecommunications company that provides wholesale connectivity to bridge the digital divide between small towns and big cities. At the time of incorporation, its ownership was shared by the Ministry of Federal Planning, Public Investment and Services (98%) and the Ministry of Economy and Public Finances (2%).

Scientific Hubs and R&D Centers



National Scientific and Technical Research Council (CONICET)

Type: Scientific Hub

Category: Directing and coordinating most of the scientific and technical research done in universities and institutes.

Description: CONICET is the agency that promotes national science and technology, e.g., astronomy. Governed by a board independent from the federal government, it funds scientific research in three basic ways: grants for collective work to research teams; a payroll of researchers and technicians workers; scholarships for doctoral and postdoctoral studies.



National Atomic Energy Commission (CNEA)

Type: Research and Development Agency

Category: Contributes to the satellite industry with micro and nano technologies, solar panels, and radar antennas.

Description: CNEA is the government agency in charge of nuclear energy research and development for peaceful purposes. CNEA operates research reactors at the Bariloche Atomic Centre in San Carlos de Bariloche as well as at the Constituyentes Atomic Centre and the Ezeiza Atomic Centre in Ezeiza in Buenos Aires.

Argentina – Companies and R&D Centers Subordinated to National Space Agency

Research & Development Centers



Aerospace Technological Centre (CTA)

Type: Scientific, Tech & Engineering Center

Category: Training in various areas of the aerospace discipline.

Description: CTA is a center dedicated to the development, research and transfer of technology and knowledge for the strengthening of the Argentine aerospace field. The CTA is promoted with the vision of continuing to bet on technological development for spatial sovereignty, as well as the training of human resources.



Scientific and Technical Research Institute for Defence (CITEDEF)

Type: Research and Development Agency

Category: Implementation of scientific research and technological development programs

Description: CITEDEF mainly conducts research and development projects for the Ministry of Defence. Among its various projects, CITEDEF developed the two Gradicom rockets. The original name was "CITEFA" (Institute of Scientific and Technical Research for the Armed Forces). Its participation and findings were key in the development of weaponry and warfare materials.

Research & Academia



Argentine Institute of Radio Astronomy (IAR)

Type: Research Institute

Category: Promoting and coordinating the research and technical development of radio astronomy.

Description: The UNLP houses the Argentine Institute of Radio Astronomy (IAR), which conducts research on astrophysics, compact objects, gravitation and numerical relativity, interstellar medium, planetary science, pulsar astronomy, massive stars, and machine learning. The IAR also houses two single-disc radio telescopes and two antennas to study radio astronomy.

New Zealand Aspires To Become a Locus of Commercial Activity

New Zealand is a unique example of a young space sector primarily driven by commercial activity. New Zealand is also one of the few countries from which a thriving, market-driven launch sector has emerged. Unique to the growth path of New Zealand's space sector is the presence of a major (American) commercial launch company, Rocket Lab at its spaceport. Ultimately, New Zealand aims for sustainability, agility, and collaboration.

Top subsectors of space revenue



Include applications making use of satellite signals and data

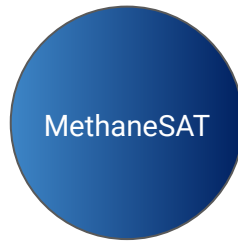


Includes the design and/or manufacture of space equipment and subsystems.



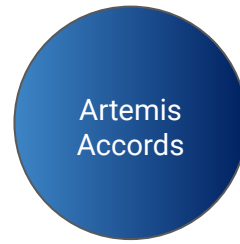
Include organisations involved in the provision of specialised support services.

Spaceflight programs



About

In November 2019 the agency signed a partnership with the Environmental Defense Fund, an American non-governmental organization, to work on MethaneSAT, an Earth observation satellite.



About

On 1 June 2021, the NZSA signed the Artemis Accords, making New Zealand the 11th signatory of the accords.

New Zealand Space Agency



The New Zealand Space Agency is the public service department of New Zealand charged with "space policy, regulation and business development" relating to space activities in New Zealand. Set up in 2016, it is the lead government agency for space policy, regulation and sector development.

Budget In 2019 \$ 2 690 000

- 2016 Establishment of NZSA
- 2017 NZ enacted the Outer Space and High Altitude Activities Act
- 2018/9 NZ's space budget was NZD \$3.8M
- 2018/9 MBIE spent a further \$6.02M on research
- 2021 1Space Agreement with NASA

Scientific Hubs & Research Centers



The Punaha Atea Space Institute, The University of Auckland

Type: Scientific Hub

Category: Research, space science, engineering.

Description: The Pūnaha Ātea – is a multidisciplinary centre of expertise in space science and engineering, including a capability to execute space missions and develop applications. Its mission is to create, disseminate and exploit knowledge to support and enhance the development of the New Zealand Space Sector. It works with national and international establishments, industrial partners and academic institutions.



Xerra Earth Observation Institute

Type: R&D center

Category: Research, EO, geospatial science, remote sensing technologies.

Description: Xerra builds tangible products and services using their research capabilities in EO and remote sensing technologies. Under its original name (Centre for Space Science Technology) it has been a successful applicant in the Regional Research Institutes Initiative, administered by the Ministry for Business, Innovation and Employment. It received establishment funding from MBIE, enabling it to stand on its own and actively contribute to the wider science community.



INSTITUTE FOR RADIO ASTRONOMY
& SPACE RESEARCH

Institute For Radio Astronomy & Space Research

Type: R&D center

Category: Research, astronomy, space.

Description: IRASR is the first (and only) radio astronomical institute in New Zealand. The main objectives of the Institute: to develop Radio Astronomy and its astronomical and Earth Science applications in New Zealand, to establish sustainable research collaborations with international observatories and world leading space agencies, to participate in international consortia for the design phase of the Square Kilometre Array project, etc

Australia Aspires to Integrate Space Technology into Everyday Life

Australia's space sector touches virtually every sector of the Australian economy and includes sending satellites and spacecraft into space as well as using space to help us communicate, locate, and see the Earth in new ways. With the sector's rapid transformation, it is the right time for Australia to leverage its competitive advantages. It has well-developed robotics, sensors, and automation technologies as well as significant capability in advanced communication. Moreover, its mining industry gives it a leg up on space resources.

Funding on space projects

Space infrastructure funding

ASA supports their domestic space industry with funding for businesses and researchers to participate in the global space economy.

International space investment

ASA is providing grants for projects that enable Australia to participate in international space agency activities.

Moon to Mars: opportunities

ASA is providing Australian businesses and researchers opportunities to participate in NASA's Moon to Mars program.

Space exploration projects

Hayabusa-2 spacecraft



Applications

The collaborative mission between both Australia and Japan – with the return of surface and sub-surface samples from the Asteroid Ryugu. The spacecraft deployed a small capsule with the extremely precious content, landing in Woomera in South Australia

Trailblazer program



Applications

The Trailblazer program is the flagship inspirational program from the Australian Space Agency's Moon to Mars Initiative, which will see the Australian space community directly involved in participating alongside NASA's missions to the Moon and Mars.

Australian Space Agency (ASA)



It is Australia's national agency responsible for the development of Australia's commercial space industry, coordinating domestic activities, identifying opportunities and facilitating international space engagement that include Australian stakeholders.

Budget In 2020 \$ 7 370 000

- 2008 First ideas for agency development
- 2009 Australian Space Research Program found
- 2018 AU\$26M for Space Agency development
- 2018 Establishment of ASA
- 2021 Communications Technologies and Services Roadmap 2021-2030

Australia – Companies and R&D Centers Subordinated to National Space Agency

Government Entities



Australian Government
Geoscience Australia

GeoScience Australia (GA)

Type: Government Entity

Category: GeoScience and research

Description: GeoScience Australia is a National geoscience organization relevant for PNT and nonmeteorological use of EO. It operates the national Satellite Laser Ranging Network, which has ground stations at Mount Stromlo and Yarragadee. The data contributes to the International Laser Ranging Service (ILRS).



Australian Government
Bureau of Meteorology

The Bureau of Meteorology

Type: Government Entity

Category: Satellite-derived products and space weather services.

Description: The Bureau of Meteorology monitors the Earth's ionosphere, which contributes to SSA data for LEO. It is providing satellite-derived products and space weather services, operating and maintaining ground stations for satellites. The Bureau is also advising the Australian Space Agency's Technical Advisory Group for SSA by providing expertise on space weather.

Scientific Hub



Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Type: R&D center

Category: Carrying research on astronomy and space science.

Description: CSIRO conducts research in environmental science, medical sciences, natural disasters, plants, and technology and space. The technology and space research at CSIRO addresses a wide array of topics, including radio astronomy technologies, telescopes, spacecraft tracking capacities, and EO applications for environmental purposes.

Scientific Hubs & Research Centers, and Academia



The University of South Australia

Type: University

Category: Education, research

Description: The University of South Australia, Australia's University of Enterprise, is a globally connected and engaged university helping solve the problems of industry and the professions. Committed to a future-focused Australia, it implements unique and innovative approaches in teaching, research and engagement, including space-related initiatives and ingenuities that seek to embed South Australia as a leader in space-related endeavours.



The Australian Centre for Space Engineering Research (ACSER)

Type: R&D center

Category: Research, education

Description: The Australian Centre for Space Engineering Research (ACSER) aims to provide national leadership for Australian space engineering research. ACSER strives to foster collaborations between researchers, industry and government and to nurture links between our national and international partners to achieve Australia's space ambitions. ACSER's purpose is to develop space capabilities relevant to Australia's needs through research, innovation and education.



Space Industry Association

Type: Association

Category: Research and development

Description: SIAA takes a leading role in advising government on behalf of the space industry. Through a program of meetings and other communications, SIAA consults with its members to devise policies to support the development of the Australian space industry and is active in promoting commercial, industrial and research opportunities for its members nationally and internationally.



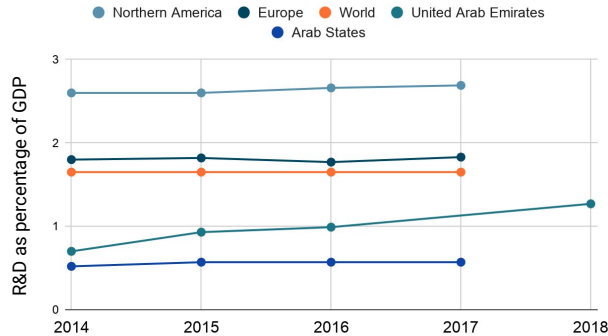
The UAE

The UAE's Space Agency doesn't have a long history, but, it isn't its history that makes it an interesting case study. Established in 2014, it has already scored some major successes, with the most notable one being a mission to orbit Mars. After a seven-month and 494 million kilometer journey, the Agency's spacecraft entered the red planet's orbit in February 2021 and began sending data about the **Martian atmosphere** and **climate**. It made the UAE the fifth space agency to reach the planet (though not land). According to the Agency, it has plans for establishing a **Mars settlement by 2117**.

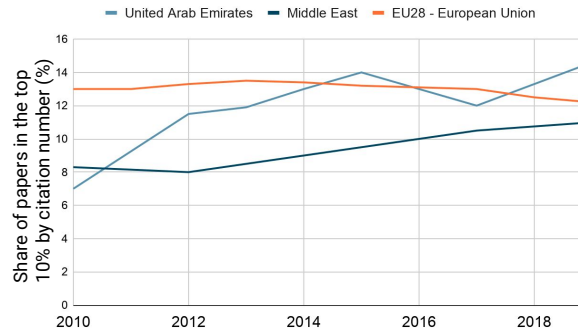
The Mars Program

The program is part of the UAE's ongoing effort to develop its scientific and technological capabilities and reduce its reliance on oil. Hence, for Emiratis, space-science goals come second. Faced with economic and environmental challenges, the small, oil-rich Gulf state hopes the Mars project can accelerate its transformation into a knowledge economy – by encouraging research, degree programs in basic sciences and inspiring the youth across the Arab states. Like major port and road ventures before it, the Mars mission is a mega-project designed to cause “a big shift in the mindset”.

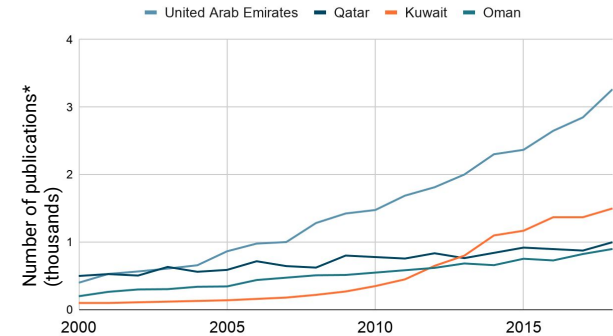
Spending



Publication Impact



Research Output



* For co-authored publications, a fraction of each paper is assigned to a country depending on its share of authors

India

India's space program has grown and evolved significantly in the past five decades. Originally developing space assets that provided direct developmental benefits, India has shifted its focus toward space exploration and other high-profile missions that do not have as clear a developmental purpose as earlier. This includes, for example, India's Mars and Moon exploratory missions.

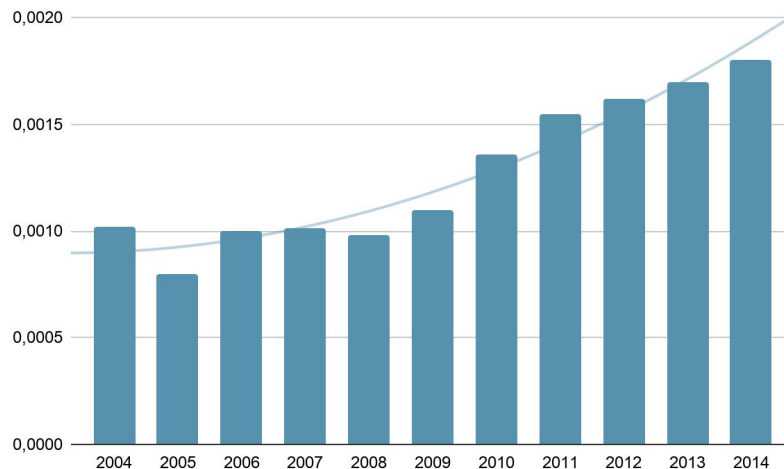
The next major step for India is a first crewed space mission, Gaganyaan, to be undertaken by 2022.

India's already robust program has also acquired national security overtones over the last decade. This is partly driven by India's growing technological capacity, but an important part of the reason for this change is the evolving security threats that India has faced, especially in relations with Pakistan and China.

This decade ISRO (Indian Space Research Organisation) has made public its intention to develop reusable rocket-launch technology and start building reusable rockets in the following decade. Meanwhile, in a "New Year Message for 2021," ISRO Chairman K. Sivan highlighted that the "space sector is facing disruption due to the entry of many private players".

Eighteen ISRO centers aim to scale up capabilities related to ground stations, human spaceflight, satellite platforms and more. The Vikram Sarabhai Space Center, in particular, was directed to continue its "competence in launch-vehicle development toward heavy-lift capabilities, achieving partial and full reusability" and scramjet engine (supersonic-combustion ramjet, a type of supersonic engine) research.

Space Expenditure as Percentage of Indian GDP



The European Space Agency (ESA)

The European Space Agency is the coordinating entity for European civilian space activities. Having twenty-two member states, it's headquartered in Paris and has several centers in other European countries. It mainly focuses on:

Combating El Nino (a weather phenomenon responsible for some of the world's most drastic and devastating disasters) and monitoring particular aspects of the environment;

Observing environmentally unfriendly factors (air pollution from transportation, power stations and industrial processes) on a daily basis, using ERS satellites, and building up a database from which one can learn and act upon;

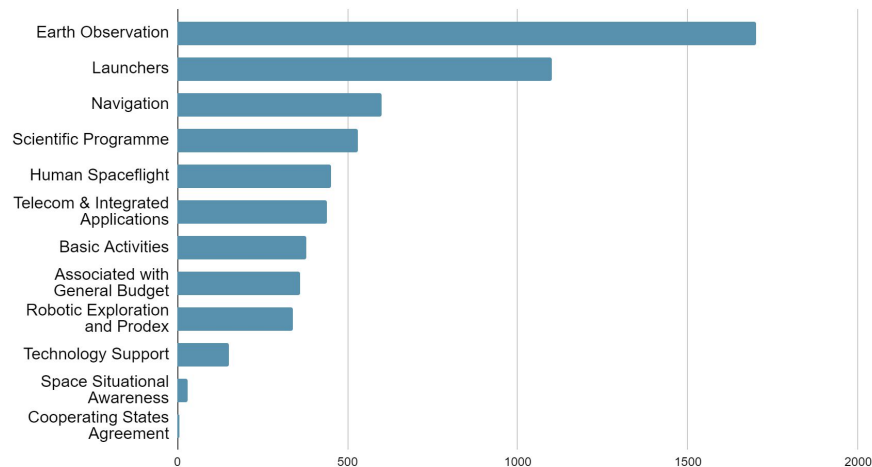
Monitoring ozone levels;

Observing polar ice caps;

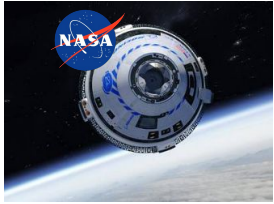
Preventing the devastation that oil pollution can bring to coastal, sea and marine environments;

Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. The ESA's purpose is to promote exclusively peaceful space exploration, cooperation among European States in space research and technology, as well as their space applications, with a view of using them for scientific purposes and operational space applications systems.

Distribution of the ESA's Budget (€M)



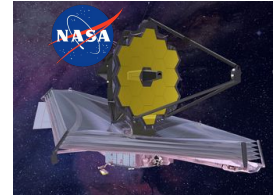
Launches and Landings Scheduled by NASA and Other Countries in 2021-2022



Date: No Earlier Than September
Mission: Boeing Crew Flight Test
Description: NASA astronauts Mike Fincke, Nicole Mann, and Barry "Butch" Wilmore are slated to launch aboard Boeing's CST-100 Starliner atop a United Launch Alliance Atlas V rocket.



Date: October 31, 2021
Mission: Lucy Mission
Description: Launching from Kennedy Space Center in Florida, Lucy will be the first space mission to study the Trojan asteroids associated with the planet Jupiter.



Date: No Earlier Than October 16, 2021
Mission: James Webb Space Telescope
Description: The James Webb Space Telescope will find the first galaxies that formed in the early universe and peer through dusty clouds to see stars forming planetary systems.



Date: 4 November 2021
Mission: Part of Artemis 1
Description: The SLS is planned to launch the Orion spacecraft and use the ground operations and launch facilities at NASA's iconic Kennedy Space Center in Florida.



Date: 2021-2022
Mission: CNSA, Tiangong Space Station
Description: In April 2021 China launched the core module of its stationary space station to Earth orbit. The carrier rocket then went to an uncontrolled fall. The other modules will be launched in the following year.



Date: No Earlier Than December 2021
Mission: ISRO, Gaganyaan
Description: Gaganyaan is a first Indian vehicle capable of containing three crew members. ISRO will launch Vyomitra, humanoid robot inside in order to conduct some tests.



Date: No Earlier Than May 2021
Mission: ESA, European Robotic Arm
Description: The Robotic Arm is going to be launched to the ISS and attached to the Russian Segment. The purpose of it is assembly work and maintenance

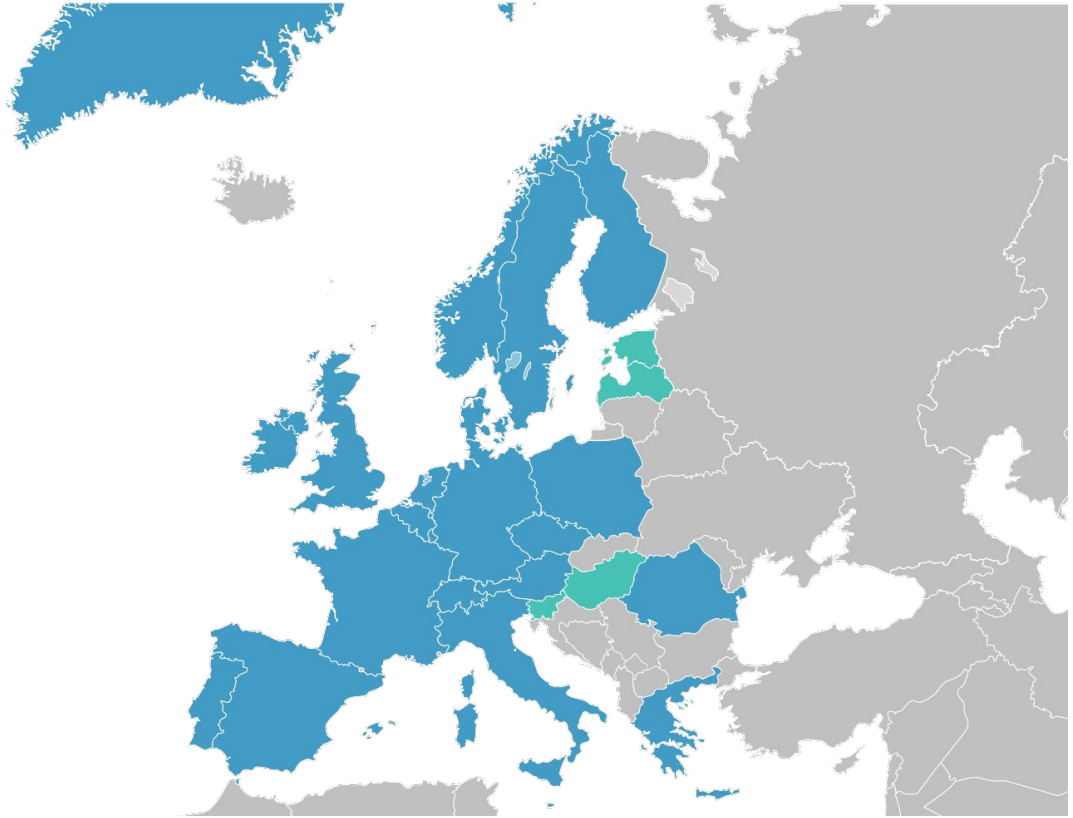


Date: No Earlier Than January 2022
Mission: JAXA, SLIM Lunar Lander
Description: Smart Lander for Investigating Moon is designed to demonstrate innovative landing techniques, that will highly improve the accuracy of landing.

ESA and Countries Contributions

ESA's activities are funded by contributions from member countries based on gross national income. About **45%** of the amount is contributed by **Germany** and **France**. In terms of funding, the top priority is Earth observation applications. The second place is occupied by the cost of the launch vehicle. Every three to four years, ESA members agree on a budget plan for several years at a conference of ESA members. Although the plan is subject to change, it defines the main direction of action.

As a rule, countries have their own space programs, which interact in different ways with ESA financially and organizationally. For example, the French space agency CNES has a budget that exceeds the funds allocated by ESA twice. The Agency coordinates work with such national programs. There are also joint projects between ESA and the national space agencies. Since 1975, more than **30 such programs** have been implemented.



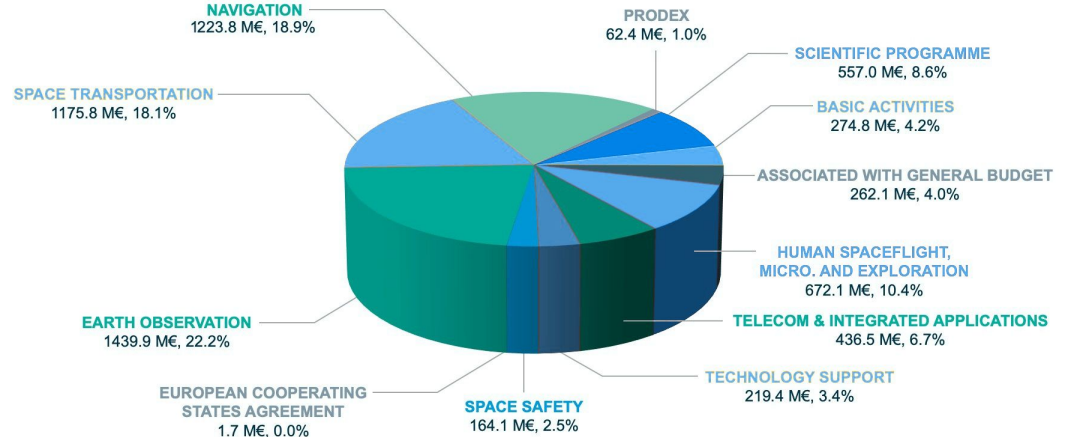
ESA and Countries Budget Distribution

ESA's activities fall into two categories – 'mandatory' and 'optional'. Programs carried out under the General Budget and the Space Science program budget are 'mandatory'; they include the agency's basic activities (studies on future projects, technology research, shared technical investments, information systems and training programmes).

All Member States contribute to these programs on a scale based on their Gross National Product (GNP). The other programmes, known as 'optional', are only of interest to some Member States, who are free to decide on their level of involvement.

Optional programs cover areas such as Earth observation, telecommunications, satellite navigation and space transportation. Similarly, the International Space Station and microgravity research are financed by optional contributions.

ESA Budget by Domain for 2021: 6.49 €B*

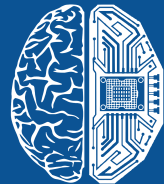


*Includes activities implemented for other institutional partners

International Collaborations in Space Exploration

July 2021

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International Organisations Involved in Space Activities

From time immemorial, understanding the universe has been an aspiration of humankind. Human curiosity has fueled interest in exploring and discovering new worlds, pushing the boundaries of the known, and expanding scientific and technical knowledge.

States and space agencies have been engaged in space activities, both competitively and cooperatively, since the first launch of a spacecraft in 1957. The first space launch led to the first **human space flight**, which, in turn, led to the first **moonwalk**. More recently, the focus has shifted to joint human and robotic missions, near-Earth asteroids, Mars and even destinations beyond our own solar system.

The current **trends** suggest that significant progress can be made in the following areas:

New Materials

Health and
Medicine

Transportation

Computer
Technology

Space exploration itself and the innovation it entails are essential drivers for opening up new domains in space science and technology, promoting new partnerships and creating new opportunities for addressing global challenges. Space exploration also motivates young people to pursue careers in science, technology, engineering and mathematics (**STEM disciplines**).

Many international organisations are deeply involved in **space activities**. Some of the most prominent ones include:

1959 - The United Nations General Assembly established a **Committee on the Peaceful Uses of Outer Space** (95 countries were members of the committee in 2020).

In 1967, the committee came up with the Outer Space Treaty, which sets forth the general legal principles governing the uses of space.

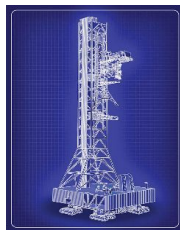
1964 - At the initiative of the United States, an **International Telecommunications Satellite Consortium** (Intelsat) was founded to develop and operate a global system of communications satellites.

By 1969 the organization had established a system of satellites with global coverage.

In 1999, the decision was made to change the ownership of the organization from national governments to the private sector (membership grew to 144 countries).

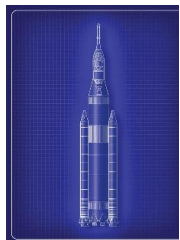
1979 - **International Maritime Satellite Organization** (Inmarsat), was established as an intergovernmental organization to supply maritime and other mobile communications services via satellite; it was later transformed into a privately-owned entity.

Artemis Program



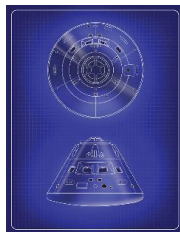
Exploration Ground System

All the Structures on the Ground Required to Support Launch



Space Launch System

Large NASA rocket that some believe is necessary to get humans back to the moon.



Orion

Spacecraft for Lunar Missions

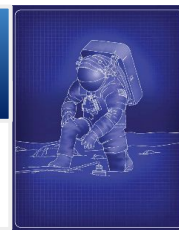


Artemis is a NASA program designed to land the first woman and the next man on the Moon by 2024. To achieve this, NASA uses innovative technologies for more in-depth exploration of the lunar surface than ever before. The program also envisages collaboration of national and private partners

The Artemis program involves 12 national space agencies from Australia, Brazil, Canada, Italy, Japan, Luxembourg, New Zealand, the Republic of Korea, Ukraine, the UAE, the UK and the US

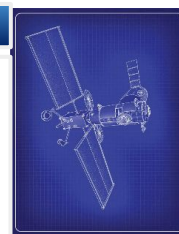
Artemis Generation Spacesuits

Modern Spacesuits for Deep Space



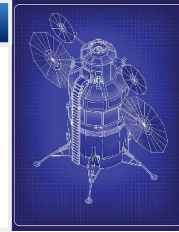
Gateway

Lunar Outpost Near the Moon



Lunar Landers

Modern Human Landing Systems



Australia



New Zealand



UAE



Italy



Japan



UK



South Korea



Ukraine



Brazil



Luxemburg



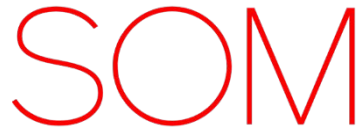
USA



Canada



**European Space
Agency**
Paris, France



**Skidmore, Owings &
Merrill (SOM)**
Chicago, IL, USA



**MIT Department of
Aeronautics and
Astronautics**
Cambridge, MA, USA

Moon Village is a Moon exploration strategy proposed by the European Space Agency (ESA) and aimed at establishing lunar habitation systems. It is less a solid plan than a vision, which encourages participation of private and national partners. However, the project is still in the early stages of development.

In 2021 the Moon Village was presented at Venice Biennale with a “Life Beyond Earth” installation.



MIT Media Lab
Cambridge, MA, USA

The Global Exploration Roadmap (GER)



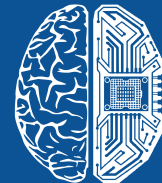
The GER is a non-binding document that smaller space agencies co-author to foster coordination and partnership opportunities. It emphasizes the importance of cooperation to realize individual and common goals and objectives for **ISECG** (International Space Exploration Coordination Group) members.



Conclusions and Key Takeaways

July 2021

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Key Takeaways

1. The key space players--the USA, China, and Russia--still dominate the industry and own most satellites.
2. The United States continues to have the highest level of space activity, led by NASA and the military. In particular, it dominates all other countries in terms of space budgets and the number of people flying into space.
3. Space is becoming relatively more accessible and affordable, allowing smaller countries to launch satellites with less effort and resources. As a result, many countries in Africa, Latin America, and Asia have begun developing space technologies. For example, Kenya and Bahrain have joined the list of countries operating satellites. New Zealand hosts Rocket Lab, a potential rival to SpaceX. However, in most countries, the space industry is still underdeveloped.
4. New space nations are appearing to challenge the world space order: Australia, New Zealand, Argentina, South Korea, Luxembourg, the Isle of Man, and the United Arab Emirates. They differ, however, in the model of space industry development, ambitions, applications, and budgets.
5. Some of the new nations have introduced new approaches to industry development such as space hubs, while some others are following the traditional paved path. The space-hub model allows nations to develop their space industries even with limited funds. It works through the creation of a favorable business environment to provide an incubator for private SpaceTech companies.
6. Economic prosperity, concomitant technological development, security issues, and prestige are among the main motives for the development of autonomous capabilities in space.
7. Many forward-looking countries are willing to invest heavily in the final frontier (the UAE space agency budget is about \$5B, and the Luxembourg space agency has a special fund for investment).
8. International cooperation and coordination are becoming particularly important. Thus, national space agencies become more critical in their ability to represent and connect multiple actors. This is reflected by the fact that their number has increased significantly in recent decades.
9. The International Space Exploration Coordination Group has united 26 countries, who have signed the Global Exploration Roadmap to foster coordination and partnership opportunities.

Key Takeaways

10. ESA is the most prominent example of cooperation in the space industry. Its most-recent budget is \$7.71B. 22.2% of the funds are allocated for Earth observation, 18.9% for navigation, and 18.1% for space transportation. The other nine categories get the remaining 40.8% of funds. About 45% of the budget is contributed by Germany and France alone.
11. In the coming years, humans are expected to visit the moon again. For governments, this will take place within the framework of NASA's Artemis program, in which twelve countries now participate.
12. The development and settlement of the Moon and Mars will require a great amount of new technologies and manufacturing capabilities, implying a need for technology and experience exchange. This will drive more international and government-business cooperation and eventually, the industry will grow even faster.
13. Strategic plans of public and private companies to explore the Moon, Mars, and other celestial bodies will increase the demand for services and products of SpaceTech companies. The ambitious goal of establishing facilities on the Moon and developing its resources could potentially reduce the cost of further space exploration and development.
14. Those countries that entered the space race in the 20th century have a significant advantage over newcomers. For example, Argentina and Ukraine are still ahead of the UAE in some ways, although they spend much less money on the space sector, while the latter has to play catch up.

Conclusions

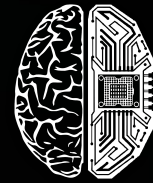
The USA with its NASA and the military is leading the SpaceTech industry by a large margin, most recently in partnership with relative newcomers like SpaceX. They have groundbreaking projects in the exploration of Mars, Venus, and Jupiter, and plan to launch the most powerful space telescope ever in late 2021. There are at least six significant launches planned for 2021, some of which has already been achieved. Russia and China are fiercely competing with the US, and starting to cooperate with each other. However, the new space nations are appearing to challenge the world space order. Much will depend on the cooperation ties between new and old players.

Agencies like the Japanese JAXA and the European ESA are focused on “peaceful use of outer space”, which means that they strive not for superiority, but for progress in technology and science through cooperation. Both agencies are focusing on sustainable means of conducting space activities, minimizing the amount of new space debris and gathering environmental data to aid in pollution reduction.

The Arab and Indian programs are continuously working to become the significant players in the Spacetech industry. Increasingly, other countries have established national space agencies and are trying to do the same, despite usually smaller budgets. These programs are showing the fastest results among newly established space agencies.



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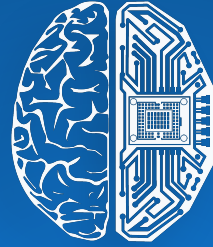
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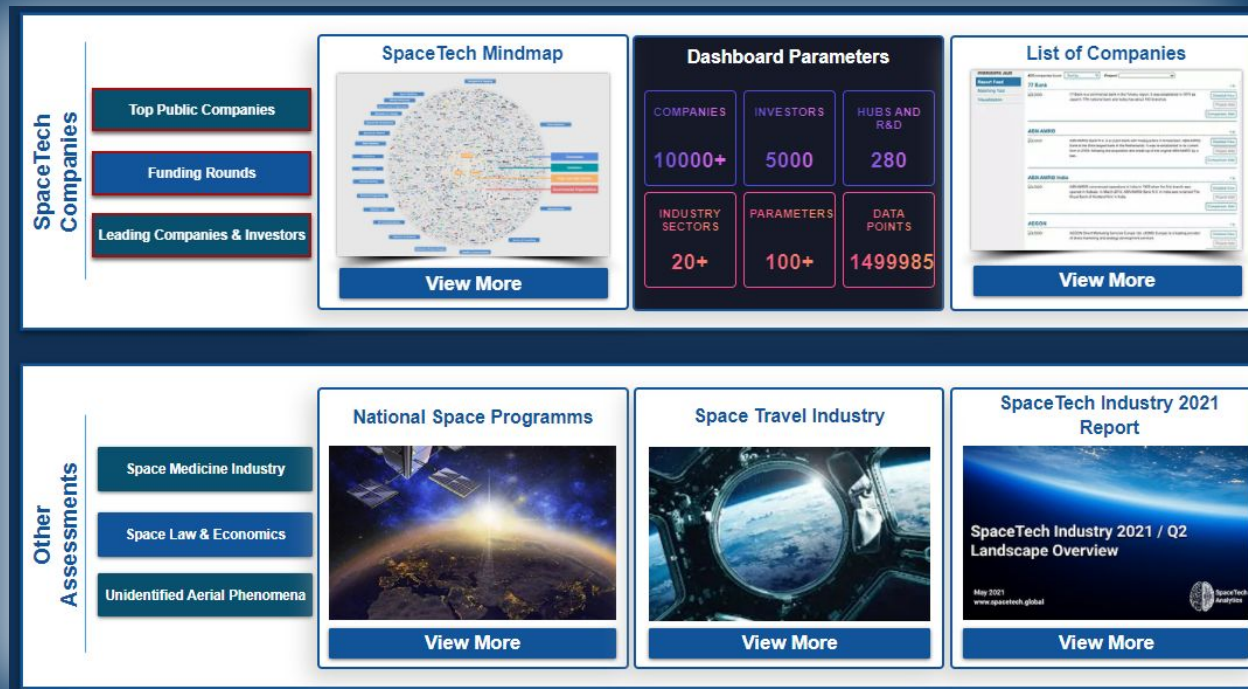
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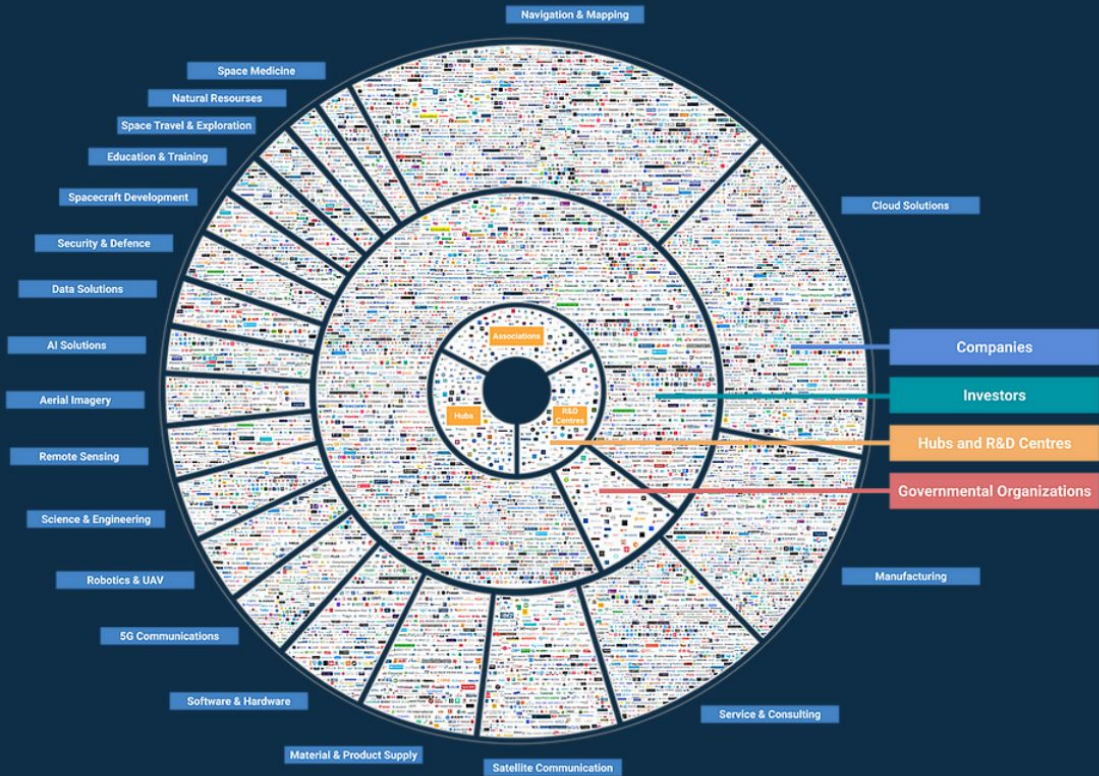


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SpaceTech Interactive Mindmap

SpaceTech Industry Landscape (by Categories)



Navigation & Mapping	Material & Product Supply
Cloud Solutions	Software & Hardware
Manufacturing	5G Communications
Service & Consulting	Robotics & UAV
Satellite Communication	Science & Engineering
Remote Sensing	Spacecraft Development
Aerial Imagery	Education & Training
AI Solutions	Space Travel & Exploration
Data Solutions	Natural Resources
Security & Defence	Space Medicine

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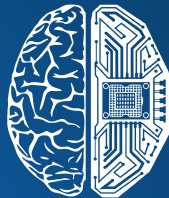
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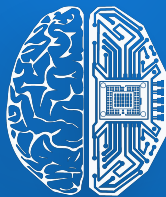
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