

For those who appreciate a holistic 360  
degree overview of the Space industry and  
its transformation on our world



## NEWS

# SPACE: EARTH'S ULTIMATE BUSINESS PLAN

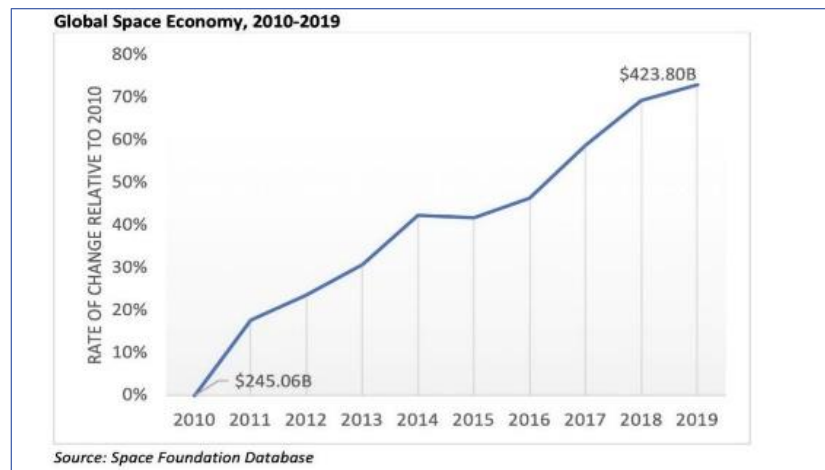
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# NEWS

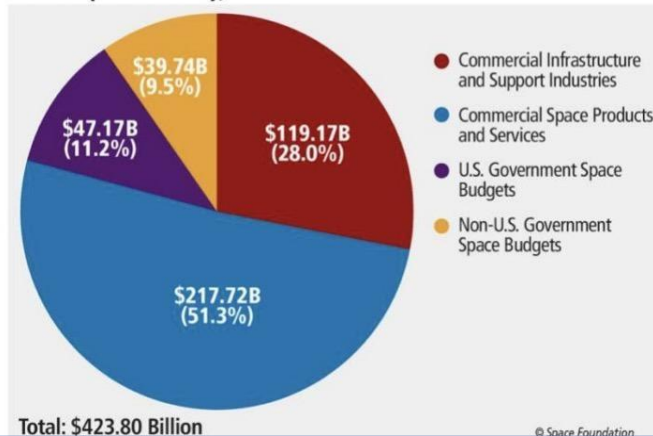
## SPACE: EARTH'S ULTIMATE BUSINESS PLAN

There's a space revolution underway—an extension of a movement with roots stretching back more than forty years. We're used to thinking of space as a place for robotic exploration missions and a handful of professional astronauts. Now, it's time to start thinking about space as a domain for commerce as well.



In 2019, there was approximately \$5.9 billion invested in space venture businesses, smashing the record set in 2018 of \$3.5 billion. For context, the global space economy in 2019 was \$432.8 billion—an increase of 70% since 2010.

**Global Space Activity, 2019**



Commercial space revenue held steady at approximately 80% of the global space economy.

For 2019, commercial revenue climbed to \$336.89 billion, up 6.3% from \$328.86 billion in 2018.

Governments collectively contributed \$86.9 billion to the global space economy in 2019, a 1% increase over 2018 and a 16% increase over the previous decade.

We often take for granted, or don't necessarily recognize, the myriad of uses of the space domain. Satellites are the low-hanging fruit of the sector, with such current uses as,

- GPS, navigation, and timing satellites
- Remote sensing satellites
- Weather satellites
- Communications Satellites

What we're now seeing are new commercial applications emerging for satellites, including

- Precision agriculture
- Commercial weather data
- Resource monitoring and management (forestries, water, fisheries, etc)
- Asset tracking & analytics
- Pollution monitoring and assessment
- Energy management (utility grid efficiency, optimizing solar production)

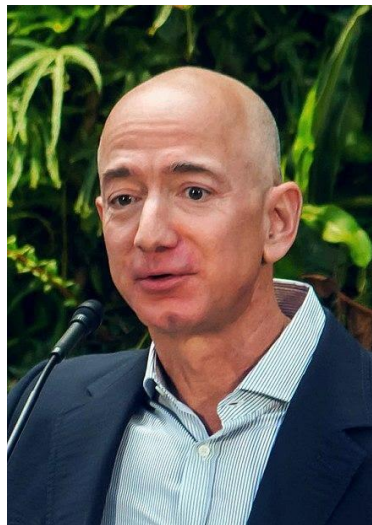
## **Astro-investor and Astro-preneur Pioneers**

There are good reasons why investors (e.g. angel and venture capital) are investing in this area. Many of these pioneering space-investors believe space could generate

outsized returns and that this historically slow moving sector is ripe for innovation and disruption.



Elon Musk



Jeff Bezos



Richard Branson

Luminaries such as the late Paul Allen, Richard Branson, Elon Musk, and Jeff Bezos share a common vision that the industrialization of space could impact life on Earth for the better. Each of them initiated or invested in different approaches. Bezos and Musk did not invest in space to make money, but rather made money in other areas in order to invest in space. It's an important distinction that gets overlooked. Bezos and Musk were both thinking about opportunities in space long before they started their respective space companies in 2000 and 2002. They all shared the notion that investment in space creates benefits from society on Earth both tangible and intangible.

The upshot is that instead of governments taking on the majority of the burden in new infrastructure development, private entrepreneurs are rallying capital and resources into their respective visions. It would be unrealistic to expect all of the efforts to succeed, but every attempt will help us understand what is possible.

## **Space as an Enabler**

The core idea of this revolution is that space is a domain and enabler for business, commerce, innovation, and more. Whether it's Musk's vision of a million person city on Mars by the end of the century, Branson's vision of millions of space tourists, or a small startup trying to provide Internet access to the whole planet, space generates new stories and could inspire new entrepreneurial activities.

## **Space is open for business, literally and metaphorically**

There are new business models emerging and a general awareness that space can provide competitive advantages. Space has mainly been a domain used as a last resort, but with increasing access, we are able to leverage the space environment to amplify and enhance many of our technological capabilities. Think flying a drone versus flying a spy satellite. They can perform the same tasks but with different levels of functions and costs. We need them both.

Three things you need to know:

1. Space as an industry is notoriously complex—which means it's misunderstood.
2. Space influences and benefits nearly every other industry on the planet.
3. Accessing space has never been easier

After the Apollo program ended, we were promised that the Space Shuttle would fly dozens of times per year with the implication that space would be more accessible.

Instead, the sector focused on low volume, highly complex systems. Being user-friendly was most likely not in the mindset of programs such as the US Space Shuttle.

## **Traditional Programs and New Paradigms**

In many ways, the inefficacy of the Space Shuttle and space program as a whole helped spark efforts to develop new space systems outside of the norm. Honorable mention to space pioneers Robert Truax, Beal Aerospace, and Mir Corp for their contributions to break the status quo, though they unfortunately didn't accomplish their ultimate goals. Governments and a few of their top contractors were not interested in additional private enterprise participation; there was no incentive for the government to have additional contractors who could create large space systems such as what Blue Origin and SpaceX are now creating, and the established incumbents like Northrup Grumman and Lockheed Martin surely had no desire for more competition—the cost-plus government contracts were extremely profitable. In essence, new commercial efforts posed a competitive threat to both NASA and its incumbent contractors.

The established incumbents continued to service both government customers and the telecommunications industry. This contracting paradigm made it particularly difficult for new entrants; it was great for the companies with the contracts, but it became a roadblock for innovative new models and opportunities.

## **Public-Private Partnerships**

For decades, governments had virtually exclusive access to space. However, over the past decade, governments became open to working with the private sector to help

support and partner on various initiatives. Governments have recognized that there are opportunities for the private sector to help solve many of its space-related challenges. One primary dilemma is access to space. After the Space Shuttle was retired in 2011, the United States no longer had domestic launch capability to send humans to space. The US became reliant on paying Russia to ferry NASA astronauts to space.



*Caption: The Soyuz-FG rocket booster with Soyuz MS-04 spacecraft carrying a new crew to the International Space Station, ISS, blasts off at the Russian leased Baikonur cosmodrome, Kazakhstan, Thursday, April 20, 2017. The Russian rocket carries U.S. astronaut Jack Fischer and Russian cosmonaut Fyodor Yurchikhin. (AP Photo/Dmitri Lovetsky)*

NASA created two innovative contract programs to help solve the aforementioned challenges. One example is the Commercial Resupply Services program, where NASA solicited services from commercial vendors to deliver cargo and supplies to the International Space Station. Contract recipients include SpaceX, Blue Origin, Sierra Nevada Corporation, and Orbital Sciences. The Commercial Crew and Cargo Program led to the development of SpaceX's Falcon 9 rocket launcher, which is single-handedly transforming the launch landscape. For around \$300 million in development costs, the US now has a reliable vehicle that is able to successfully take crew and cargo to space.

For those concerned about monopolistic practices, NASA also awarded contracts to Boeing Corporation and Sierra Nevada Corporation, among others.



*Caption: A SpaceX Falcon 9 rocket carrying the company's Crew Dragon spacecraft is launched from Launch Complex 39A on NASA's SpaceX Demo-2 mission to the International Space Station with NASA astronauts Robert Behnken and Douglas Hurley onboard. Photo Credit: (NASA/Joel Kowsky)*

The Department of Defense is also turning to the commercial sector for new solutions to enhance and augment existing space infrastructure. Although it is not expected for the DoD to turn over all of its needs to the commercial sector, it is looking at initiatives that have themes of interoperability, responsiveness, and resiliency. One example is the United States Air Force's Space Pitch Day event hosted in November 2019, where \$50 million in contract funding was rewarded on a competitive basis. Hardware startups have larger capital expenditure requirements than other startups, so the barriers to entry tend to be higher.





## **NewSpace New Infrastructure and New Applications**

Bezos shared, “How do you get that kind of entrepreneurial [advancement] in space? You need to lower the price of admission right now to do anything interesting in space because it requires so much heavy lifting and so much infrastructure development. The entry price point for doing interesting things is hundreds of millions of dollars. .... Two kids in their dorm room can’t start anything important in space today.”

The big hurdle was and still is the price to access space. Companies such as Blue Origin, SpaceX, and Virgin Galactic continue working to bring down the cost to access space, and in many ways that is already happening. Transporting cargo to space on the Space Shuttle cost approximately \$54,000 per kilogram while SpaceX’s Falcon 9 costs about \$2,700. Until entrants like SpaceX, it was virtually impossible to find a price, and even now having a price is a monumental breakthrough for those in the private space sector.



*Blue Origin's New Shepard. Credit: NASA*

Key moments like establishing a price have been critical for the commercial space sector. For decades, governments had virtually exclusive access to space. However, over the past decade, governments have become open to working with the private sector to help support and partner on various initiatives—they now recognize that there are opportunities for the private sector to help solve many of its space-related challenges. One primary dilemma is access to space. After the Space Shuttle was retired in 2011, the United States no longer had domestic launch capability to send humans to space. The US became reliant on paying Russia to ferry NASA astronauts to space.

## **New Launch Players New Value to US**

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Instead of solely thinking about space as a destination, you can also think of it as an enabler.

## Space as an Ecosystem

Let's think about space as an interconnected, multi-disciplinary ecosystem where rocket launchers are just one small (albeit important) fraction of the system. Just as the expansion of the world wide web enabled vast new applications and wealth creation, space can do even more.

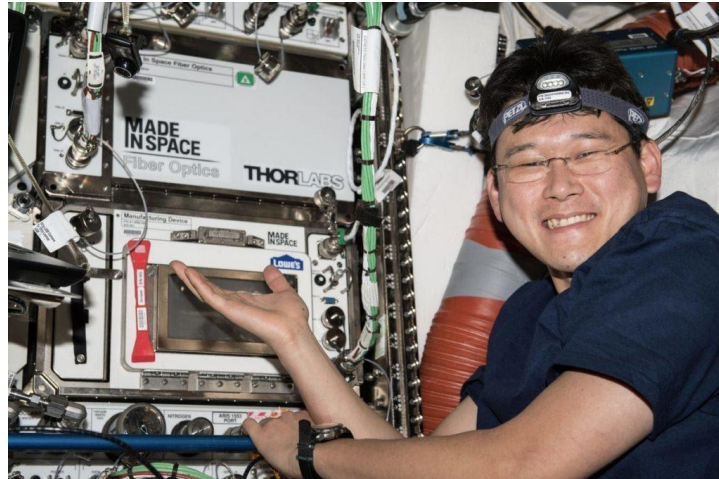
From GPS to mapping to asset tracking to Earth observation, space enriches us with vast tangible and intangible benefits. There are new business opportunities being built around data, agriculture monitoring, fishery and forestry management, maritime, and weather—all using space assets.

Government and telecom still comprise most of the annual spending on space, but an increasing amount of investment activity is flowing into new models and innovative activities.

The space environment is rich with opportunities for innovation that could yield numerous benefits to us here on Earth.

Examples include commercial product development and research on the International Space Station, which look very promising and include the creation of:

- Higher quality fiber optic cables
- Artificial retinas
- Artificial hearts and other organs created from a patient's own cells
- Single crystal semiconductor development



*Credit: Made In Space*

There is debate on how long the United States will continue to maintain the ISS, which is designated as a National Laboratory. It's a massive achievement—some have described it as a greater accomplishment than the pyramids in Egypt and argue that it ought to be preserved.

The counter-argument is that the ISS requires immense human and financial resources to keep flying. One solution is from private enterprises: there are now companies developing commercial space habitats.

## **What are the use cases for a private station?**

They could include everything from entertainment (i.e. filming in space) to industrialized medicines (i.e. Salmonella vaccine) to regenerative medicine (i.e. new organs), to materials manufacturing (i.e. ZBLAN cables). All three of these examples are already in progress.

In January 2020, NASA selected Houston, Texas-based Axiom Space to design and build the world's first clean sheet commercial space station. Axiom, which is focused on providing habitats for human spaceflight including national and private astronauts, will initially attach its module to the ISS; its intended customers are government-funded national astronauts as well as private astronauts, and Axiom has announced it will be ready to take private astronauts to the International Space Station as early as November 2021. Essentially, the company is developing real estate in space that will be available to lease. If and when the ISS is decommissioned, Axiom's module will detach and become a part of a dedicated free-flying commercial space station.



*Credit: Axiom Space*

As critical infrastructure on the ground and in space is further developed, disruptive new applications will be able to take shape. As an analog, for companies such as Google and Facebook to thrive, they required the infrastructure of servers; this technology enabled Google to gain traction with its first search product. For novel space applications to be made more widely available and useful, we need infrastructure in the form of lower-cost space launchers, satellites, and space stations. As space

infrastructure continues to be built out, we are going to see vast new applications leveraging this foundation.

These efforts are part of the industrialization of lower Earth orbit (LEO), which is the area of altitude between 160 km and 2,000 km (1,200 mi) above Earth's surface. LEO is where all human spaceflight has occurred to date, with the exception of the Apollo program's crewed lunar missions.

Much of the near-term business is connected to the utilization of LEO, primarily in data from space. Whether commercial weather forecasts, asset tracking, or emissions monitoring, a satellite is doing the work to measure the energy from Earth and return informative and valuable insights.

It is true that we have had commercial satellites for decades. Let's go back to 1999. Back in 1999, Professors Jordi Puig-Suari of California Polytechnic State University and Bob Twiggs of Stanford University created a new satellite form factor of 10 cm x 10 cm x 10 cm, known as the CubeSat. This innovation became possible in part to the miniaturization of electronics.



*Credit: wikipedia*

While initially an academic project, people started to think about in-space applications for these small satellites, which were orders of magnitude less expensive than traditional satellites. This notion of a small(er) sat was similar to what Apple's iPhone did for mobile computing.

The use cases and business models for these small satellites range from illegal fishing monitoring, weather forecasting, forestry management, Internet from space, pharmaceutical development, and more. Data from space perceived as the low hanging fruit for venture-funded opportunities.

Commercial efforts including Spire Global and Planet, among many others, emerged, taking advantage of these new, lower-cost satellite technologies. Although Planet's nanosatellites are nowhere near the price of your mobile phone, they share a fascinating origin story. The founders of Planet worked at NASA and developed the phonesat, which put a mobile phone in space. That effort inspired the founders to create a satellite business that would leverage lower cost satellites.



Early nanosatellite pioneers had the radical idea they could use much less expensive hardware that would be almost as replaceable as a mobile phone. Instead of investing in high capital expenditures that would need to be operated for years, these trailblazers intended to replace hardware frequently with newer versions at a considerable cost advantage to the traditional way of large satellites.

Granted, these smaller nanosatellites aren't as high-performance as their larger siblings. However, their costs are enticing hordes of entrepreneurs and investors to create new models based around these less expensive satellites. Today is a growing global ecosystem dedicated to this nanosatellite revolution.

## **Unicorns**

Did you know that Elon Musk's SpaceX is one of the highest valued private, venture-backed companies in the world? It is also one of the most in-demand private investment, with investors around the globe eager to invest in SpaceX stock.

You might think that seems improbable, but Musk (through SpaceX) is developing the Starlink constellation to deliver internet services via mass-produced nanosatellites, and after the third Starlink deployment in January 2020 made SpaceX the operator of the most commercial satellites in the world—182 total.

But his plans for Starlink are much greater: August 7, August 18th 2020 marked the eleventh deployment of satellites, bringing the constellation's current total to 655—out of a planned 12,000 (42,000, if the FCC approves the proposed extension). Musk's COO, Gwynne Shotwell said "we are a private company, but Starlink is the right kind of

business that we can go ahead and take public.” However, Musk shared that he has not put any thought into the idea yet.

Whether it's software or hardware, investors in NewSpace believe the sector can, and will, generate outsized returns. For investors, valuations in this area were are very attractive, even though exits in terms of IPOs are scarce. The majority of the exits to date occur through M&A.

Sector Exits:

- Monsanto buys Climate Corp for \$930 Million
- AE Industrial Partners acquires Made In Space
- Mapsense acquired by Apple
- Clyde Space merges with Swedish rival, AAC Microtech

## **Failing to Launch**

It's worth mentioning some of the recent failures in this sector, which is rife with both technology and market risks.

OneWeb, a competitor to Starlink that intended to build a constellation of satellites to provide internet access, filed for bankruptcy in March 2020 and was recently acquired by the British government and India's Bharti Global.

Small satellite launch provider Vector Launch—one of the more promising NewSpace startups in recent years—filed for bankruptcy in December 2019 after one of its primary funders, Sequoia Capital, pulled its funding support for the company.

Will investors' appetite for space startups continue through this pandemic and economic downturn? We're already seeing some consolidation, but many investors recognize that

space is a critical part of our national infrastructure. Whether it's the US Space Force, servicing the International Space Station, or developing satellite constellations to provide Internet access, the sector appears to be surviving this current global upset.

As access to lower Earth orbit increases, we are inevitably going to see a myriad of new products and services emerge. As space becomes easier to access, we will mostly be limited by our imagination to create useful new applications and businesses.

No matter what industry or sector you are currently in, I ask you to start thinking about how your business could develop a space strategy. What are services and products you could contribute or add?

For investors and entrepreneurs who would like to understand this nuanced sector, in my forthcoming book, *Space Is Open for Business*, I share many examples of space's potential to improve other industries, including the countless ways it has already transformed our world for the better—and generated incredible returns on investment.

I wrote the book for those who could appreciate a holistic, 360 degree overview of the industry and includes commentary from dozens of experts to support my thesis that space could be humanity's ultimate business plan.

I invite you to sign up for the launch of my forthcoming book, *Space Is Open for Business*, which was painstakingly crafted for the most time-challenged reader.

Space provides a triple bottom line: Return on Investment, Innovation, and Inspiration.

How will we generate massive value and profits from this growing sector?

Sign up today: <https://www.spaceisopenforbusiness.com/book>

**About the author:**

Robert C. Jacobson is a multi-faceted entrepreneur and accomplished space industry enabler, advocate, and investor. Jacobson is the founder of Space Advisors, a strategic and financial consulting firm for space startups. His decade-plus of professional experience in NewSpace includes roles at Arch Mission Foundation, where he notably worked to initiate the first Solar Library (the payload famously launched in Elon Musk's Tesla in 2018), and Space Angels (formerly Space Angels Network), the world's first space-focused angel investment group. While attending the International Space University in 2016, he was inspired to begin writing his first book, Space Is Open for Business, about the space industry's ever-expanding promise.

<https://www.spaceadvisors.com>

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Book cover for SPACE IS OPEN FOR BUSINESS