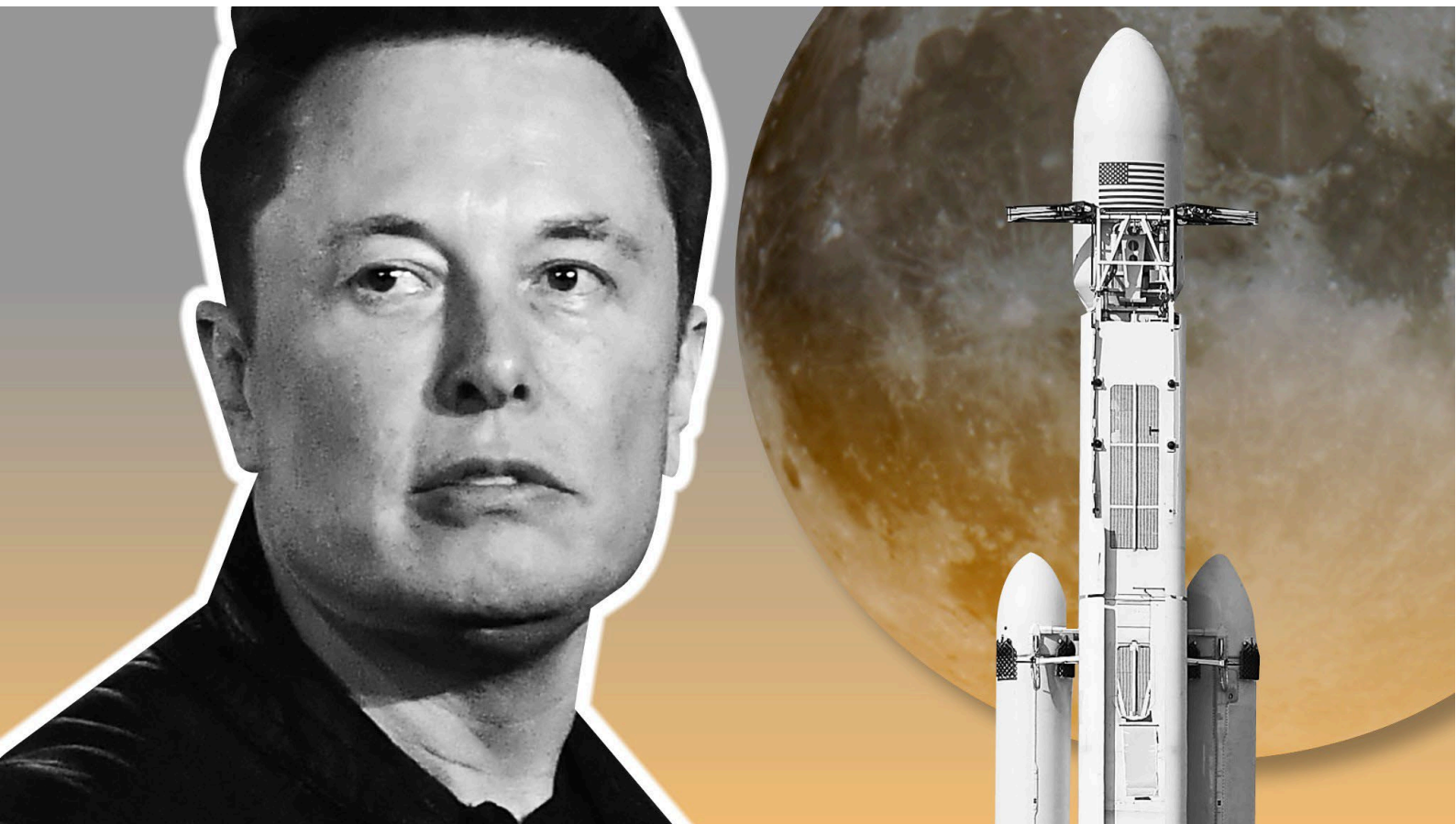


SpaceX



What is SpaceX? What has made it so popular within the space industry and beyond? What is it currently dealing with? These are some of the questions we are going to answer in this article.

After a general overview of the organization and a brief sum up of the most relevant milestones achieved over the years, the focus will shift on three fundamental projects: the reusability of Falcon 9, Starlink and Starship.

- The company

Space Exploration Technologies Corp. (SpaceX) is an American company founded in 2002 by Elon Musk (the current CEO) and is headquartered in Hawthorne, California.

Since the beginning, Musk's baseline goal has been the colonization of Mars. With this objective in mind, the company's main activities range from the development and launch of satellites and rocket engines, the resupply of space stations, to national security missions commissioned by the US government, which are carried out in conjunction with players of the caliber of Orb COMM, the US Air Force and MDA Corporation.

Despite not being listed, SpaceX has succeeded in building a sustainable competitive advantage by focusing on specific niche markets and serving specialized customer segments, such as private and institutional organizations involved in space transportation.

Although their baseline goal has not yet been accomplished, the company has managed to achieve some minor (but still incredible) successes, which reflect its innovative approach. In addition, looking back at the substantial growth that SpaceX has recently experienced, it is reasonable to think that it will continue to be at the bleeding edge of space exploration even in the years to follow.

- Milestones

From the historical perspective, few of the aforementioned successes are worth mentioning.

The first relevant milestone was reaching orbit with its launch vehicles, which was achieved in 2008 and 2012 respectively by Falcon 1 (a class of rockets) and Dragon (a space module). Later, the company had the ambition of landing those vehicles back on Earth as well, and they managed to do so on land in 2015 and on a drone-ship in 2016. Both goals were achieved by Falcon 9. The purpose of landing rockets back on Earth was to reuse them for reflight, gaining massive savings. As of today, the same Falcon 9 has been re-flown 9 times.

In addition, SpaceX has also been developing large rockets that can carry more cargo and/or more people for further distances: in 2018 Falcon Heavy had its first successful flight, while Starship is currently undergoing preliminary tests before its first complete flight, which may take place in 2021. Finally, the company also managed to send humans to the ISS in their completely autonomous Crew Dragon for the first time in 2020.

What's next for SpaceX? There are 3 major milestones that the company will achieve in the next decade: the first flight of Starship, landing on the Moon, and landing on Mars.

Now, we focus the attention on the most relevant projects currently undertaken by SpaceX.

- Reusable Falcon 9

SpaceX is committed to tackling one of the major issues that have historically constrained entrepreneurial initiatives within the space sector: the high cost of space access, substantially represented by the expensive process required to build rockets. Why is it so important to reduce the cost of space access?

Because otherwise, consequences are dramatic. First, the high cost of reaching orbit is the major factor preventing the large-scale exploration of space. Private companies are, indeed, largely dependent on public funding and cannot exploit economies of scale. Besides, it creates insurmountable barriers to entry for external companies, which, in turn, affects competition, innovation, and demand for space activities. What is the solution proposed by SpaceX?

SpaceX believes a fully and rapidly reusable rocket is the pivotal breakthrough needed to substantially reduce the cost of space access. In this direction, it has focused on the reusability of a specific class of rockets, Falcon 9, which have become the first orbital-class rockets capable of reflight. The results achieved by SpaceX so far are without precedents: it has succeeded in lowering the average cost of rockets by more than 20 times (from US\$54,500/kg of NASA Space Shuttle to US\$2,720/kg of Falcon 9)!

- Starlink constellation

Over the past few years, SpaceX has launched hundreds of small satellites into low Earth orbit (LEO) and will continue to do so until it reaches a constellation of thousands of elements. These will work to offer broadband Internet connection to anyone who subscribes to their services. The first advantage is to overcome the limits of offering telecommunications services only in certain areas, leaving large parts of the world isolated, especially at high latitudes. This represents an almost uncharted terrain for companies like SpaceX, offering a chance of huge economic returns. The Starlink constellation is 50 times closer to Earth than the geocentric orbit and will guarantee continuous pointing between them, thus reducing both the time of travel of data in space and the time it takes to process the information. The result of all this is a reduction of about 70% of the time necessary to move data around the world.

This technology is not without controversy: in particular, pollution is one of the hottest issues at the moment when it comes to space. The huge number of satellites launched into orbit has raised concerns about the possibility of obstructing the observation of phenomena in the sky. In addition, the low orbit of satellites may lead to a quick (we talk about 5 years) degradation of the orbit itself, causing possible crashes. As a result, the company has stated that it will provide its satellites with a 'light shield' in order to make them almost invisible at passage, and it will put them into orbit in such a way as to ensure a safe re-entry by burning the

entire satellites in the atmosphere. It is therefore only a matter of time before the service will be available, obviously first in America (where it is already being tested) and later in Europe.

- The Starship project

The Starship project is the next-generation heavy-lift transportation system for future space operations. Capable of rapid and reliable use, it will become the company's primary orbital vehicle and it will take cargo to orbit at a far lower cost than any other existing launch method. Potentially it could reduce the cost of taking 1 kg to LEO (Lower Earth Orbit) to just \$ 20/kg.

Starship will be a two-stage vehicle composed of the Super Heavy rocket (booster at the bottom) and the actual Starship (spacecraft at the top). When the two parts are together, the structure will measure 120m in height and 9m in diameter.

The Super Heavy is going to be the most powerful rocket ever made and it will generate a thrust of 72 MN. Just to understand how amazing it is, we could compare it to the Saturn V of Apollo 11, which had a thrust of 35 MN despite being almost the same size (111m vs 120m). On the other hand, the second module will be 50m tall with a payload capacity of 100t and it will come in two configurations (crew and uncrewed), so as to adapt to the circumstances.

The Starship system is aimed at going beyond the "simple" purpose of its predecessors to create an efficient space transportation method: as a matter of fact, it will not only improve what we can do now, but it will also be used for planetary destinations and space explorations.