THE SPACEX COMPANY

A study of innovation and entrepreneurship in space

Space Exploration Technologies or SpaceX is the first fully commercial company to launch, orbit and recover a spacecraft. And it has been awarded multiple contracts for satellite launches and supplying the International space station. But how did a company, which is less than ten years old, achieve this kind of performance level and efficiency that it is able to outbid and outperform all major players in the space business including the famous NASA?

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SpaceX was founded in June 2002 by Elon Musk with the objective of making humanity a space faring civilization, by creating cheap and efficient means of space transportation. Although the company’s objective as stated is rather idealistic the approach was from the beginning on extremely business driven and focused on continuous innovation.

DEVELOPING THE FIRST LAUNCHERS
The first major project of the company was the development of the Falcon 1 rocket. A partially reusable two-stage-to-orbit rocket, capable of bringing small satellites into low earth orbit. Designed from the ground up by SpaceX using modern technology it became the first successful liquid propelled orbital launch vehicle developed with private funding. The Falcon 1 consisted of two liquid oxygen fueled rocket stages powered by the in house developed rocket engines Merlin (first stage) and Kestrel (second stage), the latter also being capable of multiple restarts during its six minutes operating time. This feature increased the reliability and enables very accurate payload positioning.

While the Falcon 1 was used for commercial payload transport to LEO orbits it was also designed to verify and test components and structural design concepts that were intended for the second, larger, launch system which SpaceX intended to build, the Falcon 9.

The Falcon 9 is the launch system which made SpaceX a serious player in the market. Having its maiden flight June 2010 it features a two staged medium sized launcher, capable of deploying payloads of up to 26 tons to low earth orbit and 15 tons into a geostationary transfer orbit. The most remarkable design features of the Falcon 9 are its low cost of 50 Million USD per GTO launch and the reliable and fail safe structure of the design. This fail safe method consists of two important parts: the first being the hold-down feature of the launch sequence, allowing the engine to be fully running while all systems are checked to be operating properly before the rocket is released. The second aspect is determined by the failure tolerant multi-engine design in the first stage, allowing for mission completion even if one of the engines fails in mid-flight. These design properties make the Falcon 9 the first rocket since the Saturn series from the Apollo program to incorporate these capabilities. The reason for this extensive reliability was not just to achieve a high success rate but also to enable a very
important feature of the launch system: To transport astronauts into space. For this reason SpaceX developed the Dragon spacecraft. The Dragon is a ballistic re-entry capsule capable of docking with the ISS. It is designed to carry up to seven astronauts into orbit. It is constructed in such a way that the front nose is mounted with a hinge, revealing an ISS standard docking mechanism. With the vision of SpaceX founder Elon Musk the capsule was designed with the capability to re-enter from a lunar and even a mars mission entry velocity.

The first successful orbit of the Falcon9-Dragon combination was achieved on December 8 2010 and was awarded with NASA’s cargo delivery contract consisting of twelve flights to the ISS at a value of 1.6 billion USD. With this contract SpaceX will be the main US supplier of the ISS with the end of the Space Shuttle missions.

BUSINESS STRUCTURE
A short look at the timeline of this young company already raises curiosity for people who are familiar with the usual development time and technological progress of space companies. The space business is notoriously slow on changes and innovations since the extensive tests and reliability requirements for space approval often lead to the decision of using proven technology rather than innovative solutions.

The answer can be found in the way in which SpaceX is set up as a business. Being a lifelong enthusiast of innovation, Company founder Elon Musk did not want to rely on old space proven technology or veteran aerospace testing firm but prefers building new components and testing them in house as well as developing the rockets in quick succession reusing many components and design manufacturing strategies.

A factor which allows SpaceX to profit greatly from new technologies on the market is the use of modern off-the-shelf technology which is then integrated into the space systems. This was for example done with the control systems of the Falcon series which are based on an Ethernet network.

The major difference between SpaceX and its more traditional competitors is the fact that it is not run like a bureaucratic aerospace firm. Since Musk believes the high prices of other space-launch services are driven in part by unnecessary bureaucracy SpaceX is rather run like an Internet technology startup comparable to Musk’s other firms. The company is based on the philosophy that simplicity, low-cost, and reliability can go hand in hand. This is achieved by eliminating the traditional layers of management in the internal structure, reducing bureaucracy, while externally the number of sub-contractors is kept as low as possible in order to speed up decision making and delivery. Another way to cut costs and increase efficiency is Musk’s objective to keep as much of the manufacturing in house as possible, which reduces the costs and keeps a tighter loop between the design and manufacturing team. This increases the quality and the speeds up the innovation process since improvements and new ideas are easily put into practice.

This approach has already shown impressive results allowing SpaceX to both underbid and outperform its direct competitors, but is still an ongoing process. Musk has stated that one of his goals is to improve the cost and reliability of access to space by ultimately a factor of ten.

FUTURE
The fact that progress has not slowed down at SpaceX with the late achievements has been yet again proven with the development in progress of the Falcon series. It entails expanding the design to the recently announced new launcher, the Falcon Heavy, a grossly sized up expansion of the Falcon 9 capable of carrying twice the payload of the currently largest launchers, the Space Shuttle and the Delta IV Heavy. Interesting about this launcher is the fact that it would actually be powerful enough for interplanetary missions, which fills our imagination with curiosity and interest not just about the future of SpaceX but also of human spaceflight.

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PORTRAIT: ELON MUSK

Elon Musk is an American engineer and entrepreneur best known for (co-)founding PayPal, Zip2, SpaceX and Tesla Motors.

Born in 1971 in South Africa, Elon Musk moved to Northern America to study business and physics. After finishing his degrees he later said he considered three areas he wanted to get into that were “important problems”: “One was the internet, one was clean energy, and one was space.” He realized the first one when he founded the internet company Zip2, in 1995 which was bought by AltaVista for 307 Million USD four years later. In 1998 Musk co-founded the internet payment service known as PayPal, which was later acquired by eBay. After these first internet endeavors Musk founded SpaceX in 2002 where he held the position of CEO and CTO striving to make space more accessible to mankind. His interest in technological innovation and clean energy also lead to the co-founding of Tesla Motors, a widely known producer of electrical cars, where he holds the function of chairman and product architect.

As recognition of for success as an innovator and entrepreneur Elon Musk has received various awards, including being listed as one of the 100 people who most affected the world in 2010 and the Living Legend in Aviation by the Kitty Hawk foundation. His unconventional yet inspiringly successful style has also reached Hollywood, where movie director John Favreau used his person as an inspirational basis for Marvel’s Iron Man character Tony Stark.