

# SPACE TRAVEL PRIVATIZATION BY SPACEX

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## ABSTRACT

*In 1970, the Indian Space Research Organization (ISRO) started the Satellite Launch Vehicle (SLV) project, a small-lift launch vehicle project (Muegge, 1970). Since its introduction in 1970, with a mission to launch satellites into space using a rocket-powered vehicle, the SLV market has grown exponentially and is currently valued at \$2B (Clark, 2013). The Congressional Research Service classified SLV under aircraft and spacecraft industries and exercises, focusing on space-related services for telecoms and satellite navigation. This case study summarizes Elon Musk's aspirations, conflicts, and milestones to develop his company, SpaceX, into a leading private commercial spaceflight venture to visit Mars. The SpaceX project's primary barriers were overcome by vertical integration, with four launch locations across the United States (Mosher, 2019). The SpaceX project covers over 100 missions, representing over \$12B in revenue to transport astronauts to the International Space Station (Maddox, 2021). Elon Musk follows innovative principles and reusability to decrease the overall cost of an SLV. This case study discusses entrepreneurship, self-determination, and management, to give readers a deeper understanding of this industry. SpaceX provides employees freedom, inspiration, and maintenance of operational control. Elon Musk demonstrates that success can be achieved by seeking autonomy for entrepreneurship, authoring, and creating change.*

**JEL:** G0, H0

**KEYWORDS:** SpaceX, Elon Musk, Space Launch Vehicle, Rio Grande Valley, Mars

## INTRODUCTION

This case study summarizes Elon Musk's aspirations, conflicts, and issues to develop his company, SpaceX, into a leading private commercial spaceflight venture to visit. SpaceX has brought down the cost of its current rocket Falcon 9, to less than \$30M per launch (Ben-Itzhak, 2022). The cost reduction is generated by landing the most expensive part of the rocket and reusing it multiple times. Elon Musk stated that the next-generation rocket would be far less expensive per launch, "I'm highly confident it would be less than \$10M," Elon Musk said. During the last 15 years, commercial space activity increased from \$110B in 2005 to \$357B in 2020 (Be-Itzhak, 2022). Morgan Stanley forecasts an industry growth of \$1T by 2040 (Sheetz, 2022). This case study discusses entrepreneurship, self-determination, and management, to give readers a deeper understanding of this industry. SpaceX provides employees freedom, inspiration, and maintenance of operational control. Elon Musk demonstrates that success can be achieved by seeking autonomy for entrepreneurship, authoring, and creating change. The remainder of the document is organized into eight sections: Abstract, Introduction, Literature Review, SpaceX, Management Novelties at SpaceX, A path Forward, Concluding Comments, and Biography.

In October of 2020, Elon Musk launched the 100th mission of SpaceX. Elon Musk's SpaceX, a next-generation reusable rocket project, aims to revolutionize the industry, representing over \$12B in contracts. The mission of SpaceX is to affect and innovate the space industry by building an entrepreneurial sector and creating new non-traditional investor entrants (Clark, 2013). This case study focuses on reviewing entrepreneurial activities by Elon Musk to establish and expand SpaceX using publicly available resources.

This private commercial spaceflight venture is currently one of the fastest-growing launch service providers (Mosher, 2019). Additionally, SpaceX focuses on the next generation by deploying reusable launch vehicles capable of carrying humans to Mars and farther destinations in the solar system (Parietti, 2021). Elon Musk provides a path to demonstrate innovation with renewable rockets by improving the cost and reliability of access to space for satellites and humans.

Entrepreneurship and innovative activities perceive as “groundbreaking” with “paradigm-shifting potential” (Parietti, 2021). SpaceX’s strengths come from applying theory building with careful observation and accurate description (Parietti, 2021). According to Yin and Eisenhardt, defining aspects and explanations are strengths of the case study research designs. Therefore, this case study covers highly affected technology innovations influencing SpaceX theory, technology building, and entrepreneurship. The emancipation perspective of entrepreneurship connects verbs and actions rather than nouns and things (Muegge, 1970). Therefore, this case study describes entrepreneurship activities led by Elon Musk that have brought profound changes to the space industry. SpaceX earned worldwide attention as the first private company to return a spacecraft from a low Earth orbit in 2010 (Eldridge, 2021).

This case study focuses on Elon Musk’s decision to become an entrepreneur in “New Space,” referring to the recent commercialization of the space sector. Elon Musk saw an opportunity to seek autonomy in an industry driven by constraints, wherein the apparent barrier to human exploration beyond the low Earth orbit is the high cost to access space. He sought to create dreams and fight these constraints by striving to send humans to Mars, demonstrating that change is possible by using cost-efficient methods. SpaceX aspired to change, build, and launch space vehicles, operating differently from government-run projects through privately held contracts. According to Clark, by the end of 2020, SpaceX had over 100 successful launches, accounting for an estimated \$4B in revenue (Clark, 2013).

Many investors have sought to purchase stock, but SpaceX is a privately-owned rocket company that does not allow shareholders. Many speculate that the company will issue a public stock offering after making a successful trip to Mars. This company can save significant money from reinvesting in different needs by building reusable rockets. The advantage of private operation is its ability to promote the company’s goals. Today, SpaceX has 3,000 employees working on developing three different space vehicles. In 2026, the company expects to reach its primary goal of visiting Mars safely.

Meanwhile, the company focuses on entering into more government contracts to complete successful launches. Elon Musk’s space project, Starlink, will comprise 12,000 internet satellites by 2027 (Mosher, 2019). Elon Musk’s SpaceX Company will control and operate most operational spacecraft in orbit if this goal is successful. The goal is to cover the Earth with high-speed, low-latency, and low-price internet access. Starlink’s implementation will benefit the economic sector and allow internet access to remote rural areas. However, some competitors fear that SpaceX might encroach on similar projects to build global satellite-internet constellations. Both One Web and Amazon, with their Project Kuiper (Mosher, 2019), expect to deliver high-quality internet access.

## LITERATURE REVIEW

SpaceX, founded in 2002 and headquartered in Hawthorne, California, is a relative newcomer to the aerospace industry flourishing in Southern California since the 1950s. However, the aerospace industry is focused on transforming spaceflight, making affordable journeys into space a reality. SpaceX entered the aerospace industry with the Falcon One rocket, a two-stage liquid craft, to send a small satellite into orbit (Eldridge, 2021). SpaceX changed the industry pattern for launching rockets by focusing on reliability and cost to match the launch demand. It is the first private company to successfully launch spacecraft at the International Space Station (ISS) and then return them to Earth (Eldridge, 2021). When Elon Musk first entered the space industry, his competitors viewed SpaceX as an “unrealistic upstart” (Eldridge, 2021).

However, these competitors did not appreciate how Elon Musk would change the realities of the spaceflight business: “Yet, SpaceX managed to offer some services at a cost of 20% to 30% less than its competitors” (Eldridge, 2021). Therefore, SpaceX’s low-cost model was embraced, and the company became the leading authority on private spaceflight, distinguishing itself from other businesses in the industry (Karami, 2021). According to Liskowczyk (2016), SpaceX overcame entry barriers for the respective industries by implementing a unique technique to the space business. This research demonstrates that SpaceX, driven by Elon Musk, overcame entry barriers through their sizeable initial investment and the vertical integration implementation. SpaceX adhered to guidelines to use reusability and decrease the cost of an SLV. This research suggests that other companies might join together to build a more robust and healthier SLV industry with support from the U.S. Air Force. Furthermore, this research can assist the government in recognizing companies and technologies in their early life-cycle that can bring potential to the SLV industry at a lower cost.

Therefore, the drive of the research, led by Liskowczyk, is to understand how SpaceX entered the SLV industry by practicing innovative techniques and business practices. The SLV industry is small and leaves few options for customers to engage. The average cost to the U.S. Air Force is \$225M from the United Launch Alliance (ULA); this creates a problem since it leads to a more considerable risk for U.S. taxpayers (Liskowczyk, 2016). SpaceX entered the industry and quickly developed several innovative projects to provide a commercial option to launch satellites into space. Action based on this research represents assistance to the U.S. Air Force to inspire more competition in the industry. Therefore, the U.S. Air Force should reassure vertical integration to address the cost-prohibitive startup cost, allowing for the implementation of new assembly strategies and manufacturing processes.

Continuing with our literature review section, now we discuss research made by Muegge, S. & E. Reid. (2019). This research problem consists of identifying and describing the New Space activities of Elon Musk. The authors’ work contributes to the theory and practice of innovation by adding descriptive case studies that examine the process. The results and methods are of specific interest to the space industry entrepreneurs, managers, analysts, and officers at governmental space agencies (U.S. Air Force). This research examines the action taken by Elon Musk divided into six perceived constraints: (1) space was boring, (2) tech companies address low-impact problems, (3) entrepreneurs give up control of companies, (4) U.S. launches required Russian launch vehicles, (5) no humans on Mars, (6) shared belief in cost-reductions. Mr. Elon Musk escaped these constraints by launching SpaceX, creating an opportunity to inspire and be in control, demonstrating that change is possible, and eventually transporting humans to Mars.

## **SPACEX**

According to Wattles (2018), Elon Musk’s mission with SpaceX was to design, manufacture, and launch advanced rockets. He founded the company to revolutionize space technology to transport humans to other planets with the ultimate goal of establishing human settlements on other planets. Elon Musk was born in South Africa in 1971, and after obtaining degrees in economics and physics at the University of Pennsylvania, he moved to Northern California’s Silicon Valley in 1995.

Upon moving to Los Angeles in 2001, Elon Musk surrounded himself with the world’s top aeronautics thinkers, which helped him realize what he wanted to do in space. Even before he founded SpaceX in 2002, Elon Musk’s goal was to establish a human settlement on Mars, thus making humans a multi-planetary species. SpaceX has three space vehicles and over 6,000 employees and has effectively made over 100 launches. As one of the world’s fastest-growing launch service providers, SpaceX continues to build capable vehicles that can carry humans to various destinations in the solar system (Wattles, 2018).

Space X's growing performance began declining in 2019 due to an increase in unsuccessful launches. This case study analyzes every step to build their current success, with 2019 as the starting point. 2020 was a news-filled year for SpaceX and the space industry, and the company was busy with the earliest successful launch of its start ship prototype (Karami, 2021).

While the National Aeronautics and Space Administration (NASA) focused on landing its Perseverance rover on Mars, SpaceX's busy ride began in December 2019 with the explosion of its SN8 prototype, and the company expected to send its next prototype with Raptor engines to the Launchpad this year (Karami, 2021). On February 2, 2021, the SN9 test lifted off after SpaceX and the Federal Aviation Administration (FAA) agreed on safety waivers. The test launches of Starship prototypes continue from Boca Chica, Texas, throughout the year as they prepare for the prototype's first orbital flight scheduled for the end of 2021 (Karami, 2021).

SpaceX has ambitious spacecraft launch plans and other projects based on the 2019 incomplete and failed projects (Jackson, 2021). For example, on January 6, 2021, Falcon 9 launched the third set of 60 Starlink satellites. This added two missions and in-flight tests to the company's Crew Dragon spacecraft (Jackson, 2021). Another ambitious spacecraft launch in 2020 was the deployment of the Starlink broadband constellation, which led all business launches, according to Gwynne Shotwell 2020, President and chief operating officer of SpaceX. The SpaceX launch rate, combined with NASA, U.S. Air Force, and commercial customers, doubled compared to a slow 2019, with 13 launches, and to 2018, with 21 launches (Sheetz, 2022). The launch rate in 2019 declined by 40%; SpaceX.com included a three-month gap between launches from August to November 2019.

However, the declining performance was not due to issues related to the rocket; a lack of customers ready to launch caused it. This issue involved the commercial communications satellite market, and Shotwell stated, "This is the first year that we are seeing that we are now ready to fly our customers before they are ready" (Foust, 2020). In addition to the performance decline, SpaceX does not have a clear timeline for completing the space vehicle. The required launch license or permit from the FAA's Office of Commercial Space Transportation can delay any launch.

According to Elon Musk, the delays in starship development originate from "new technology development schedules that exhibit a version of Zeno's paradox - at any point, you're halfway there" (Federal Aviation Administration, 2021). The year 2021 had the potential for more good news with two SpaceX launches, including sending astronauts to the ISS and NASA launching a rover to collect a sample from an asteroid 200 million miles from Earth (Eldridge, 2021).

However, a negative for SpaceX is the lack of employee training, leading to declining company performance and decreased productivity. When a company such as SpaceX proposes something revolutionary, there will always be skeptics (SpaceRef, 2011). Some speculate the company will find it challenging to match the quality control to succeed.

However, with the launches of Falcon 9 and Dragon, SpaceX has lowered launch costs. According to Chinese government officials, SpaceX has the best launch prices globally, making a strong case for American innovation outshining lower labor costs found overseas (SpaceRef, 2011). During the World Satellite Business Week conference, SpaceX performed 10 launches, including four Starlink missions. However, this satellite program had its challenges. To avoid failure in space missions and consequent losses, the company has tested with the U.S. Defense Department, including equipment costs and terminal availability (SpaceRef, 2011).

## MANAGEMENT NOVELTIES AT SPACEX

Conflicts have arisen in the Texas neighborhoods over the expansion of SpaceX's Boca Chica facility. In March 2020, Elon Musk announced on Twitter that he was planning to create a city at Boca Chica Village and its surroundings and name it "Starbase": "Please consider moving to Starbase or the greater Brownsville/South Padre area in Texas and encourage friends to do so!" (SpaceX, 2021) Elon Musk exhorted.

Before SpaceX began operations there, the Texas beachside community of Boca Chica was a place for residents and visitors to enjoy outdoor activities, including dirt biking and fishing. Today, there is continuous traffic flow on the lone highway as tourists come in droves to photograph the steel spaceships under construction. Excavators work at construction sites at night, leaving residents sleep-deprived. Following Cameron County regulations, residents receive notices suggesting that they temporarily vacate their homes for safety before test launches. Additionally, the closure of State Highway 4 was implemented (Salazar, 2021).

However, Elon Musk believed that creating the city of Starbase would help private spaceflight companies attract future employees and improve their business. "SpaceX's hiring needs for engineers, technicians, builders, and essential support personnel of all kinds are growing rapidly," Elon Musk stated (SpaceX, 2021). Currently, the company has over 100 open positions (Duffy, 2021). Additionally, Texas State law requires a potential municipality to have at least 201 inhabitants (Rodriguez, 2021) who would be required to vote on the potential incorporation of a city. As of March 2021, SpaceX owned 110 parcels of land in Cameron County, and Elon Musk's dream of creating a city was inching closer to reality, with Elon Musk predicting, "Starbase will grow by several thousand people over the next year or two" (Duff, 2021).

Not all Cameron County residents approve of SpaceX operations. Safety for residents is crucial; Cameron County Judge Eddie Trevino has said that if SpaceX wants to remain in the area, it will be required to abide by state laws (Tribune News Service, 2021). Therefore, SpaceX is considering expanding to Austin, Texas, but they have not announced formal plans. Elon Musk stated that a new engineering facility might be needed (Carlson, 2021). Elon Musk's plans for Starbase are influencing the housing market and the economy of South Texas. Real estate agents in the area recognized buyers and investors ready to acquire land, particularly near the rocket production facility and launch site in Brownsville and South Padre Island (Bondarenko, 2021).

Data from the Brownsville/South Padre Island Board of Realtors show that, during March 2021, the median price for a single-family home rose 14.2% to \$177,000 (Bondarenko, 2021). Experts observed a lack of available accommodation; an economist and associate professor of Economics and Finance at the University of Texas Rio Grande Valley added that the inventory of houses available would hold for only another month, and prices would increase accordingly. Contreras added that Cameron County currently focuses on building permits for apartment complexes, but houses are not being built. "Retail is also benefiting," said Contreras. "Let's remember that some 12% of all employees in the Rio Grande Valley (RGV) are tied to the retail sector" (Rodriguez, 2021). Cameron County elected officials are working alongside market experts to grow the economy and attract more visitors to the region.

Besides the market expansion crisis faced by the valley, the new wave of migrants arriving at the United States' southern border under President Biden's migration overhaul plan is just miles away from SpaceX's Starbase test facility. Biden's plan allows migrants to enter the United States while acquiring protected legal status.

In Brownsville, Texas, there is a 300-yard distance from the metro bus station, and immigrants advocate celebrating new arrivals hoping for a change and economic opportunity in the U.S. New technologies for

additional border security will be placed near the SpaceX launch site. Biden's measure involves limited arrests and deportations with supervisor approval (Salazar, 2021).

In addition to the delays in the launch schedule, the SpaceX satellite project faces scrutiny due to growing concerns. For example, in 2019, the European Space Agency had to fire thrusters on its Aeolus satellite, raising its orbit to pass safely over Starlink 44, one of the first 60 satellites in SpaceX's Internet constellation. The maneuver occurred 30 minutes before a potential collision (Foust, 2020). Astronomers have raised concerns about the bright appearance of Starlink satellites. According to SpaceX, a bug in the paging software used to alert satellite operators was the reason for this problem (Foust, 2020). This issue was discussed at a special session at the 235th meeting of the American Astronomical Society in January 2020.

SpaceX continues to face setbacks as it develops new equipment. In February 2020, the pressurization test severely damaged a version of its next-generation launch vehicle starship. The vehicle's completion timeline is unclear because it requires a launch license from the FAA's Office of Commercial Space Transportation (Foust, 2020), as it can take several months to obtain this license.

Elon Musk encourages his employee's freedom, inspiration, and maintenance of operation control by providing a place to gain and share knowledge. Elon Musk's leadership style involves empowering young engineers to learn from others and develop new ways to solve problems. Josh Boehm, a former Space X employee who collaborated with Tesla- COO & Co-Founder Cyph.com, explains how Mr. Elon Musk encourages his employees to work long hours.

SpaceX culture seems to be a common misconception; no one forces you to work long hours, especially not Elon. SpaceX focuses on hiring self-driven people who are passionate about every mission. The long hours are what it takes to get the job done, particularly if they are limited resources. Mr. Josh Boehm describes the working environment in a rocket factory as being "amazing on its own." The team culture and environment contribute to their success; having encouraging speeches by Mr. Elon Musk will gather everyone outside of a mission control before the launches.

Having open office space contributes to seeing everyone working hard, creating a mentality of not wanting to let anyone down and respecting all their hard work. SpaceX is very flexible, lets employees work remotely when possible, and manage their schedules. By focusing on results, allowing freedom and creativity to arise. The culture at SpaceX involves working with different departments, closely monitored changes, and high communication skills, "Choose a job you love, and you will never have to work a day in your life." Their success comes from employees' dedication and self-driven personalities, creating an enjoyable working experience.

## **A PATH FORWARD**

Concerns about SpaceX's operations continue to grow in Cameron County, and decisions traced to allegedly poor leadership are now being questioned. According to Bolton (2021), SpaceX's launches in South Texas were frustrating for residents. While some Cameron County citizens believe that the company's expansion is good for the economy, others believe it threatens the community (Bolton, 2021). At a recent Brownsville City Council meeting on May 25, 2021, residents complained that SpaceX displaced residents, pushed away local businesses, and caused environmental damage. One highway leading to Boca Chica Beach must be closed during SpaceX activity, and according to the Cameron County website, the beach was closed for 12 days in May 2021 (Bolton, 2021).

Elon Musk is hiring several thousand people to work at SpaceX Starbase in Texas (Maddox, 2021), specifically engineers, technicians, or builders ready to move to Brownsville/South Padre, Texas. Currently,

SpaceX has over 1,000 job openings, with 109 in Brownsville, ranging from senior software engineers to thermal hardware specialists and from heat shield builders to pipefitters. The 2014 Brownsville Economic Development Council projected that SpaceX would generate \$85M in economic activity in Brownsville, with \$51M in annual salaries by 2024 (Blankley, 2021).

The primary focus of SpaceX was on manufacturing and launching rockets and spaceships (Trefis Team and Great Speculations, 2018) affordably through its reusable rocket technology. In addition to making significant technological advances, the company generates money by launching satellites in Earth's low orbit and transporting cargo to the ISS (Trefis Team and Great Speculations, 2018). SpaceX's strategy is to charge customers less per launch than its competitors, allowing for a small profit margin and creating more opportunities to refine and advance the launches. Research and development are long-term goals (Trefis, 2018).

According to O'Kane (2017), SpaceX's reusable rockets offer direct competition to airlines that transport passengers to a location, reach a low orbit, and return safely. For example, SpaceX could use the Falcon 9 rockets to fly the proposed routes from Hong Kong to Singapore in 22 minutes, London to Dubai or New York City in 29 minutes, and Los Angeles to Toronto in 24 minutes (O'Kane, 2017). This future Earth City-to-Earth City travel method would be the fastest ever created by humans. With the rocket reaching 18,000 mph, Elon Musk stated that it would be "more than an order of magnitude faster than the Concorde" (SpaceX, 2021).

Forecast envisions SpaceX holding the largest market share in the commercial satellite launch industry (Trefis Team and Great Speculations, 2018), owing to its lower cost per launch than its rivals. According to Forbes.com, five of the 18 SpaceX launches in 2017 involved reused components, allowing faster turnaround. SpaceX minimizes the downtime between launches by reusing components, reducing even more time in the long run.

In 2015 and 2016, SpaceX had two launch failures, which negatively affected the number of launches in the following years (O'Kane, 2017). Therefore, SpaceX considered collaborating with its largest competitors, NASA and Iridium. The resulting fixed prices for the launch of commercial satellites (Trefis Team and Great Speculations, 2018) offered sizable discounts to customers. The number of successful launches increased, with experts forecasting a rise from 31 to 45 within 2021 (Trefis Team and Great Speculations, 2018).

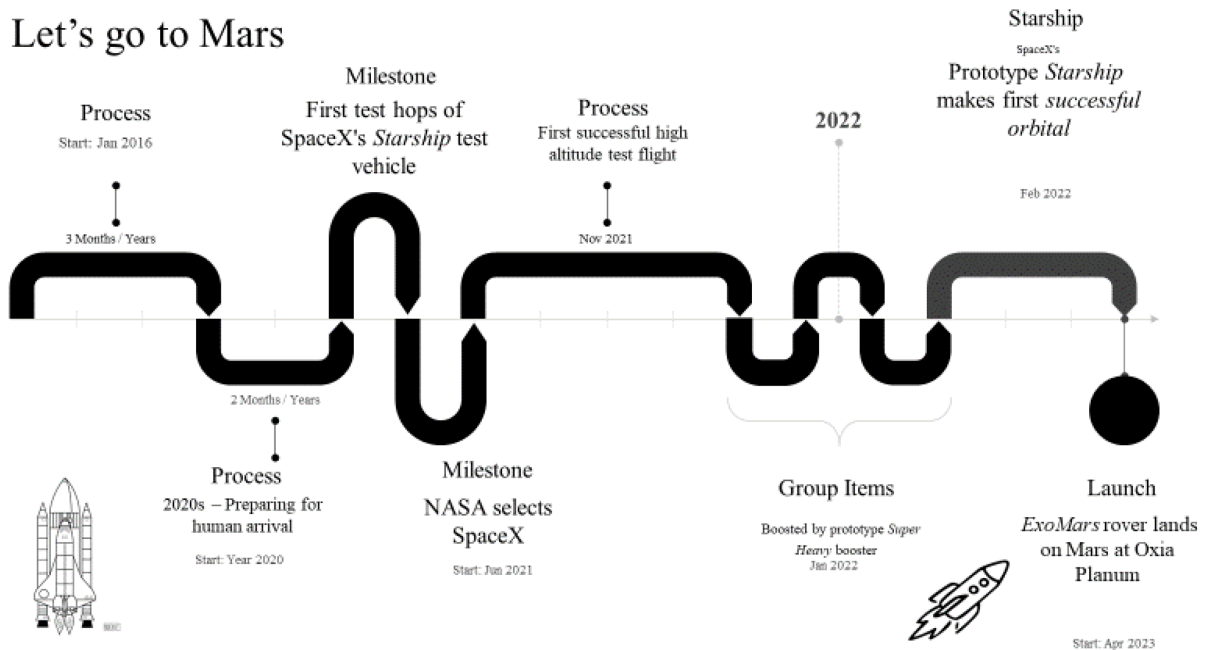
According to an article by Brian Calvert (2020), "the Elon Musk dilemma" revolves around poor actions and their consequences. Calling Elon Musk a billionaire executive, not a leader, Calvert states that his two greatest ideas involve electric vehicles and the settlement on Mars. A world powered by electric vehicles would create environmental benefits but require burning more fossil fuels. Building more nuclear facilities (Duffy, 2021) and drawing tremendous amounts of rare materials would damage landscapes, people, and plants and ignite wildfires. Last, Calvert contends that citizens should demand a vision focused on current problems instead of on "magic vehicles" or "settlements on inhospitable planets."

Besides negative feedback and comments from people opposing Elon Musk's vision, SpaceX has been profitable since 2007 (SpaceX, 2021). According to Forbes, SpaceX has seen dramatic growth in jobs, infrastructure, and operational investment. SpaceX practices over 40 flights, representing more than \$3B in revenue (Trefis Team and Great Speculations, 2018). It plans to reduce prices in the long term by launching reusable vehicles. Currently, China has the fastest growing economy globally (Eldridge, 2019), but the American free enterprise system will ensure that the United States remains the world's superpower of innovation (Clark, 2013).

As one of the greatest entrepreneurs today, CEO Elon Musk leads the industry by using green technology and Tesla: “When something is important enough, you do it even if the odds are not in your favor.” (Niekerk,2021). SpaceX’s notable achievements involve Falcon 1, the first privately developed liquid fuel, and the first commercial provider launch to recover spacecraft from orbit. SpaceX serves as an example of effective project management by taking opportunities and trades on every project and pursuing beneficial methods and successes.

SpaceX promotes employees' communication, leadership, and risk management skills to inspire the practical design of reusable rockets. I think SpaceX and space exploration might move forward positively since the company has contributed tremendously to the spaceflight vernacular. Elon Musk dreams of creating reusable rockets to do commercial spacecraft and, involving advanced technology, building a new area of the space industry. Something that the NASA space shuttle was not able to continue to enhance. Today, 20 years later, SpaceX is a force that provides crewed missions to the International Space Station. Reusable rockets and spacecraft technology are the future as they allow for lower operations costs than competitors. SpaceX's aspirational goal has been to land the first humans on Mars by 2023. Figure 1 shows SpaceX estimated timeline to visit Mars.

Figure1: Timeline



This figure shows the estimated timeline for SpaceX to visit Mars. Starting with the year 2020, the company's first design. Elon Musk’s aspirational timeline for reaching Mars allows SpaceX to send cargo ships to Mars in 2022. SpaceX’s ultimate goal of enabling human life on Mars to obtain permanent human colonization. The launch to visit Mars is planned for April 2023.

The implications of SpaceX policy, practices, theory, and subsequent research can influence the use of fully reusable launch vehicles. Elon Musk saw a need to understand why rockets were so expensive and wondered “how efficient you can be about getting atoms from a raw material state to rocket shape” (Chaikin, 2012). Elon Musk said that reducing the number of processes can result in “huge cost savings,” Elon Musk said. According to data analyzed by Salinas, SpaceX draws approximately \$80M in capital investment for each launch, creates 600 direct jobs paying \$50M in direct annual salaries at 50% above average county wages, generates 400 indirect jobs, produces \$70M in economic effect, and attracts 10-15K visitors per launch (Jackson, 2021).



Additionally, SpaceX offers internship opportunities for students, a space visitor's center, a museum, new curricula in school districts, entrepreneurial opportunities, the development of new aerospace clusters, and job opportunities throughout the Rio Grande Valley and South Texas (Rodriguez, 2021). According to the SpaceX website, whenever someone proposes to accomplish a brand-new task, there will be skeptics. Elon Musk's strategy with SpaceX is to reduce costs by reusing rockets, bypassing the lower labor costs found overseas (SpaceRef, 2011). Elon Musk has cost savings; however, it depends on the frequency of launches. After the failure of the Falcon 9 rocket on February 15, 2021, SpaceX investigated to avoid further errors and gathered data to rebuild Falcon 9's flight. Elon Musk responded to criticism of the failure by stating, "SpaceX is in this for the long haul, and, come hell or high water, we will make this work" (SpaceX, 2021).

Elon Musk's tenacity has allowed SpaceX to close a contract with NASA for supply runs to the ISS. The most recent one was in June 2021 (Bergin, 2015). SpaceX benefits the space technology sector through its innovative technological solutions. SpaceX's two strategies focus on helping NASA reduce the costs of technological innovations and provide multivendor options. Additionally, SpaceX focuses on reducing the cost of sending astronauts into space, program development, and spacecraft development. Reusable rockets have given SpaceX the benefit of lower costs for space transportation (Wattles, 2018). 3D printing technology can reduce the cost of mass production. In addition, SpaceX is working on journeys to Mars by reusing rocket technology to refill rockets in orbit and expand space travel by producing propellants on Mars. Increasing space travel launch costs have been a challenge in the past decade, and prices have declined because of commercial rocket development, though they are still high.

The high costs include the capital requirements of building single-use rockets with high system complexity. This low failure tolerance opened an accessible exploration for Elon Musk's reusable rockets to be tested. The reuse of rocket technology is where SpaceX has been successful, and a trip to Mars will require refilling the rockets in orbit. The ability to produce propellants on Mars is a challenge for future research. One of the significant challenges SpaceX will face by March 2024 is the requirement for half of the satellites to be launched by the Federal Communications Commission (Federal Aviation Administration, 2021). The commission reserves telecommunications for the Starlink system, requiring SpaceX to deploy satellites as soon as possible.

Additionally, SpaceX has to update the "de-orbit plan" to show how to handle space debris from deteriorating satellites. "We aspire to launch in late 2024 with an arrival in early 2025," Elon Musk informed reporters after his presentation at the International Astronautical Congress in Guadalajara, Mexico. "That's optimistic, so I would describe that as an aspiration and within the realm of possibility, but a lot of things need to go right. That said, I do not think it would be significantly beyond that if it did go later" (SpaceX, 2021).

SpaceX's biggest competition in the commercial launch market is Arianespace. Although SpaceX claimed almost half of the market last year, the request for the launch of Geo Satcom has not yet been approved. The U.S. Air Force manages national security space programs and awards development contracts for launch vehicles. SpaceX was one of the four competitors denied an award, although it had struggled for years to obtain military launch certifications for its workhorse Falcon 9 rocket. SpaceX can still compete in the second phase of the program. The company had grandiose plans to develop a new launch vehicle or rocket engine capable of supporting human-crewed missions to Mars. However, the U.S. Air Force was looking for something simpler, similar to the rocket-like Falcon 9.

This company has had high and low milestones since 2002. The primary goal of obtaining U.S. space travel function after NASA canceled the shuttle program. The company's most important rocket launches, landings, and payloads are discussed in this section. The first successful flight of Falcon 1 lasted only one minute in September 2008. Falcon 1 successfully achieved orbit, becoming "the first privately-developed liquid-fuel rocket to reach Earth's orbit," according to SpaceX (SpaceX, 2021). The vehicle was launched

five times. The SpaceX Dragon spacecraft is a capsule designed to carry astronauts and emergency supplies to the ISS. This primary spacecraft was launched into orbit in 2010.

The Dragon landed in the Pacific Ocean close to the coast of Mexico. This was the first time a private spacecraft returned from orbit, another incredible achievement for the company, the first private company to dock with the ISS. Since that mission, SpaceX has sent Dragon to the ISS on resupply missions for NASA. Finally, Falcon Heavy's first launch became the leading rocket in commercial satellite launch flights. This rocket can carry 141,000 pounds (Eldridge, 2021) and is said to be fully reusable. The Starship prototype SN10 was developed in Boca Chica, Texas, and successfully launched in March 2021. Technology development is one of the main reasons Elon Musk originally founded SpaceX, and his main goal was to send humans to Mars and develop the aerospace industry (Eldridge, 2021). Elon Musk attempted to rearrange the established status quo of the traditional space industry. He did this by first becoming rooted in the social communities of the space industry through investing in unconventional launch vehicles and building SpaceX with personal funds as a Silicon Valley space company.

SpaceX uses unconventional launch facilities and reusable components for cost-effectiveness while securing commercial contracts. As a Silicon Valley space company, the organization quelled the notion that the space industry had not developed in the last 50 years. Aerospace companies faced little competition with higher, expensive products that never reached maximum performance. SpaceX's end-to-end modular engineering platform was created using unconventional launch facilities (Clark, 2013). Elon Musk's ambitions to transport humans to Mars shaped all decisions in the system architecture. Finally, commercial contracts with NASA and the U.S. military to develop technology to operate missions allowed SpaceX to become the first private spacecraft to dock with the ISS.

SpaceX Launchpad witnessed the explosion of four out of five of its Starship prototypes. Every time a rocket blows up, it affects the natural area surrounding Boca Chica, and pieces of machinery lie along the southern Gulf coast. A member of the art collective Las Imaginistas, aiming to connect officials and lower-income residents in the Rio Grande Valley, vociferously expressed the adverse effects of SpaceX in the area. The South Texas Border Community is concerned about land expansion in the testing area: "Any SpaceX expansion would be occupying more land considered sacred to the local indigenous Carrizo Comecrudo tribe." Residents face disruption every time they are told to leave their homes before a SpaceX launch.

In March 2021, Elon Musk encouraged people to move to the Brownsville area claiming that he had created new jobs in engineering, infrastructure design, and other sectors. Residents of Brownsville lamented, "The jobs being created aren't for us" (Salazar, 2021). The biggest concern is that the jobs in Brownsville are low-wage jobs. Even if the cost of living in the city increases, it would not force residents to leave their homes. Lastly, residents complained about beach access: "Now its control. You cannot get in or out whenever you want to. It's only when they allow it, based on what's happening at SpaceX" (Salazar, 2021). Boca Chica Beach is an integral part of the culture in South Texas, and SpaceX does not allow citizens to go fishing during launches due to security concerns. This case study examines SpaceX's history, highlighting the company's innovative strengths and weaknesses.

SpaceX is a tremendous source of inspiration for junior engineers, astronauts, and professionals, who can learn by working with a visionary company. Its founder allows employees to step outside their comfort zone and fuel their ambition and creativity. According to a representative of Recticel Flexible Foams, those working for Elon Musk must accept discomfort, "But in that discomfort is the kind of growth you can't get anywhere else, and it is worth every ounce of blood and sweat" (Karami, 2021). SpaceX has attracted global attention as it is the only private company capable of returning a spacecraft from a Low-Earth orbit to Earth. With the launch of Falcon Heavy, the world's most powerful rocket, SpaceX could achieve one of its goals:

developing highly reliable, reusable, cost-effective, reusable rockets (Trefis Team and Great Speculations, 2018). Elon Musk did not deny that SpaceX and Tesla can't fail, but that did not stop him from trying.

## CONCLUDING COMMENTS

This paper summarized Elon Musk's aspirations, conflicts, and milestones to grow his company, SpaceX, into a leading private commercial spaceflight venture to visit the moon and Mars. In addition, the approach used the case study methodology to develop my recommendations. In this methodology, different cases were considered to form an idea of the research to help its foundation according to the literature reviews from studies.

The primary recommendation from this case study is to continue to track SpaceX's achievements and be able to compare the economic expansion in the SLV market. In addition, to inspire readers to learn more about the space industry by providing examples of success achieved by SpaceX autonomy. Limitations in this paper include finding data from former and current SpaceX employees about their experience working for the company. Through SpaceX, Elon Musk created something unique, testing rockets innovatively. Elon Musk's career lesson became an example of perseverance. He proved that conventional wisdom and persistence are extremely important, and quitting should be considered only when forced (SpaceX, 2021). Future recommendations for SpaceX engineering teams are to focus on the resources of the Big Falcon Rocket. The space community and SpaceX, in particular, should be more committed to adhering to deadlines. For instance, at the announcement of Falcon Heavy in 2011, Elon Musk declared that the rocket would fly within "a few" years, but it took seven years until the launch (Wattles, 2018). In 2020, SpaceX continued the space shuttle's legacy by flying NASA astronauts to and from the ISS on American vehicles for the first time since 2011. SpaceX's vision is to embark on the next space adventure to achieve a human-crewed mission to Mars and ultimately establish a settlement on the Red Planet (Wattles, 2018).

SpaceX benefits the space technology sector through its innovative technological solutions. SpaceX's two strategies focus on helping NASA reduce the costs of technological innovations and provide multivendor options. Additionally, SpaceX focuses on reducing the cost of sending an astronaut into space and reducing expenditures on program development and spacecraft. 3D printing technology and reusable rockets allow SpaceX to reduce the costs of mass production (Wattles, 2018).

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