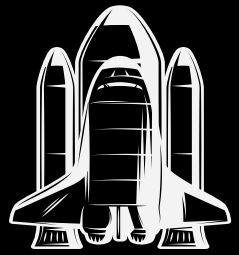
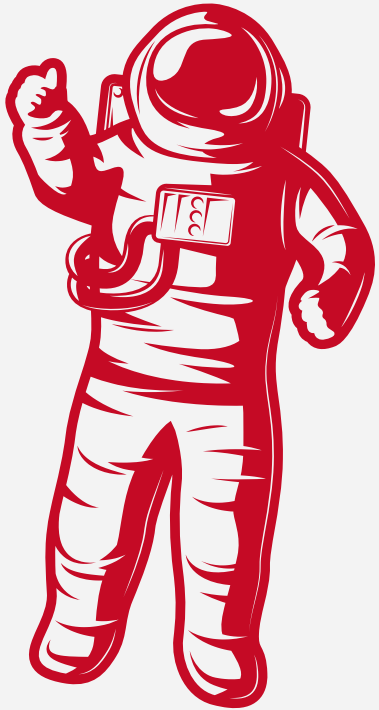


EXPLORING SPACEX
ASTR 311

Austin Daniels, Ethan Jones, Luke Shorting,
Evan Dyce

01

Historical Influencees of SpaceX



Historical Influences

Key Missions Shaping Space Travel

- Apollo: First moon landings, deep-space navigation
- Space Shuttle: First reusable spacecraft, ISS construction

From Government to Private Sector

- NASA-led missions dominated early space travel
- Private companies now drive innovation and cost reduction

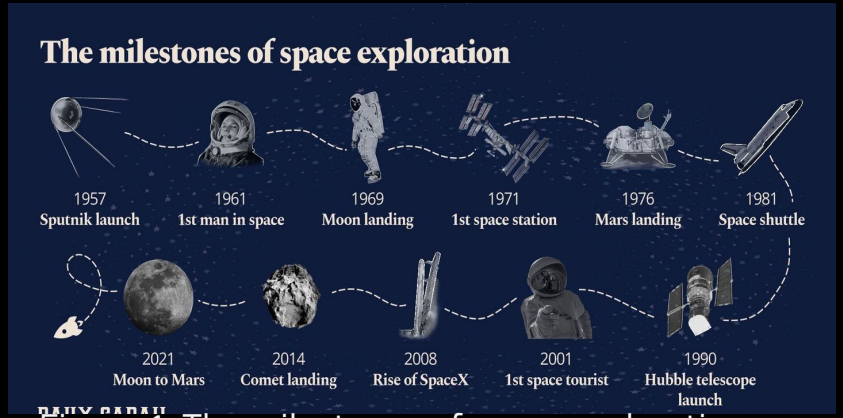


Figure 1. The milestones of space exploration (Daily Sabah, 2021)

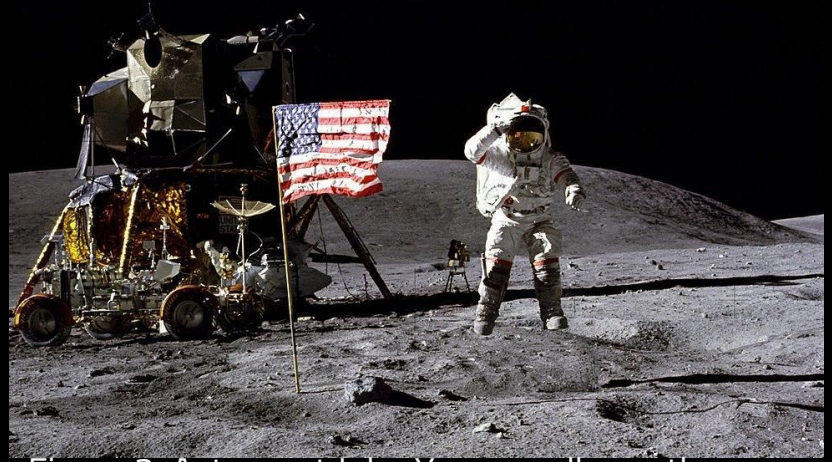


Figure 2. Astronaut John Young walks on the surface of the Moon (BBC, 2024)

The Apollo Program

Moon Landing and Legacy

- 1969: Apollo 11 landed on the moon
- Proved deep-space travel was possible

Key Tech Innovations

- Saturn V Rocket: Most powerful rocket of its time
- Lunar Module: Engineered for Moon landings
- Navigation and Planning: Paved the way for future missions

Figure 3. Apollo 11 crew (Britannica, 2025)

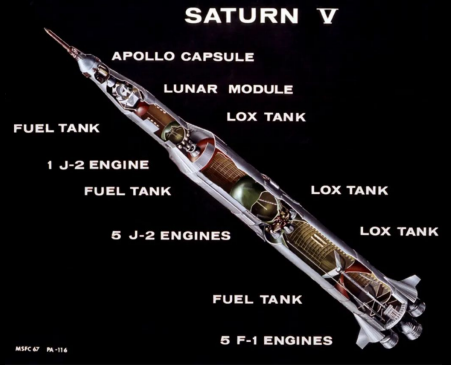


Figure 4. Saturn V (NASA, n.d)

The Space Shuttle Program

First Reusable Spacecraft

- Reduced launch costs compared to disposable rockets

Shaping Reusable Rockets Today

- Inspired SpaceX's Falcon 9 reusability

Expanding Space Access

- Built and supplied the ISS
- Deployed and repaired satellites

Figure 5. Shuttle launch profiles (Wikipedia, 2025)

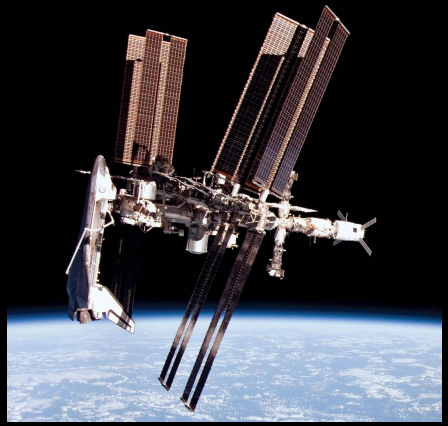


Figure 6. ISS (Wikipedia, 2011)

Shift to Private Spaceflight

Budget Constraints to Public-Private Partnerships

- NASA partners with companies for cost-effective solutions

Commercial Crew Program

- SpaceX Crew Dragon and Boeing Starliner transport astronauts

SpaceX's Influence

- First private company to send humans to orbit
- Falcon 9 and Starship: Fully reusable, reducing costs
- Partnering on Artemis lunar lander

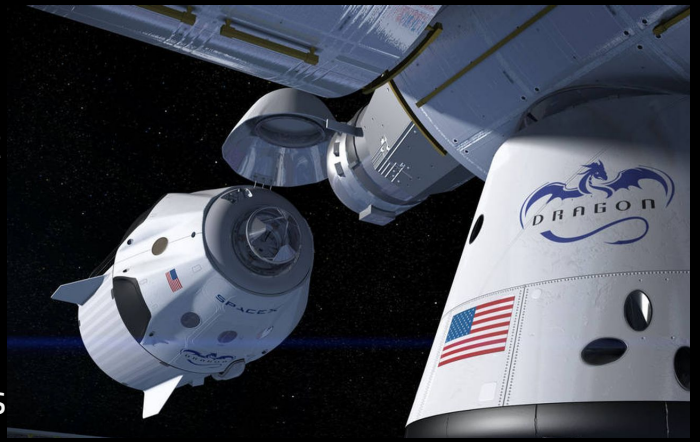
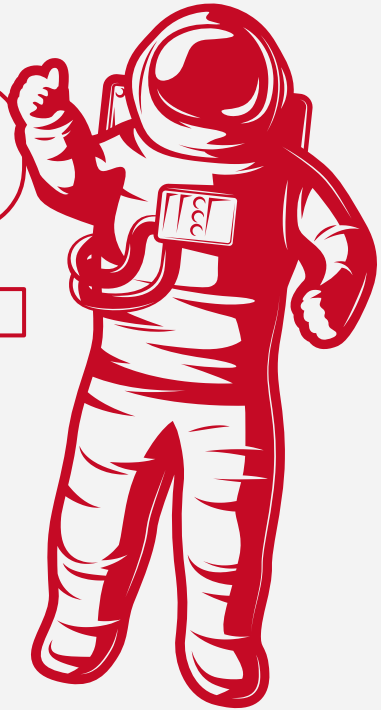


Figure 7. SpaceX Crew Dragon (NASA Kennedy, 2014)

02

SpaceX Contributions to Modern Astronomy



ROCKET REUSABILITY

How It Works

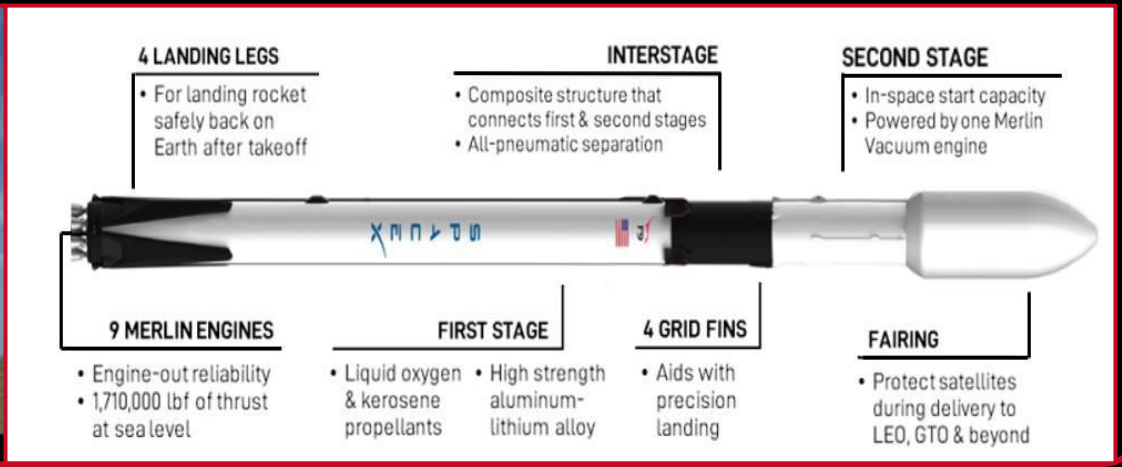
- 2 Stage Rocket
- First Stage Flips and begins descent to earth

Benefits

- Main Benefit is Lowered Cost
- More Frequent Launches (87 in 2015, to 263 in 2024 with SpaceX accounting for over 50%!)

Figure 8: Falcon 9 Landing. Retrieved from https://giphy.com/gifs/buzzfeed-rocket-landing-falcon-heavy-3ohs4x1nhZMTEdCC08

Figure 9: Falcon 9 Architecture. Retrieved from https://www.spacex.com/media/falcon-users-guide-2025-03-14.pdf



SpaceX Starship

- SpaceX's super heavy rocket and spacecraft
- Payload capacity of 100 metric tons (~17 Elephants)
- Allows Design to be secondary factor

Starships Effects on Astronomy

- Has already been chosen as the lander for Artemis III (2027)
- New Great Observatories?
- Contrast with Ariane 5

Figure 10: SpaceX's Starship landing. Retrieved from https://www.cnn.com/science/live-news/spacex-starship-launch-5-10-13-24/index.html

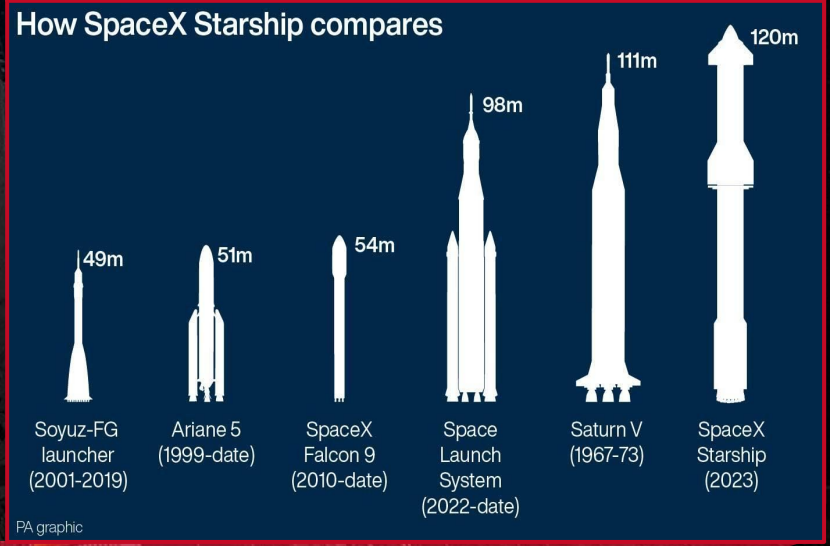
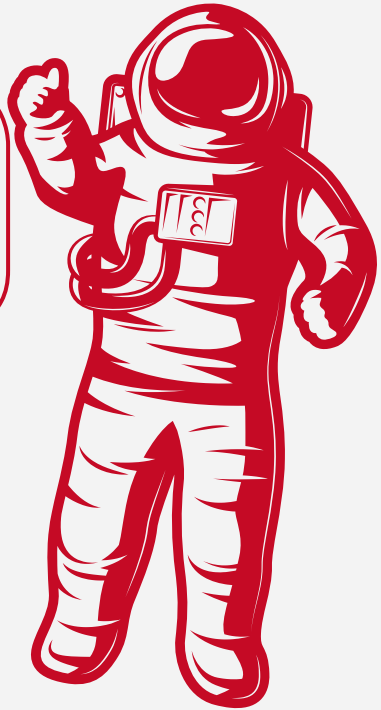


Figure 11: SpaceX Starship size comparison. Retrieved from https://www.uniladtech.com/science/space/spacex-starship-elon-musk-153626-20231117

03



Mars Colonization

Is it Feasible?

Mars Mission Plan

- Elon Musk is quoted stating that unmanned Mars missions are scheduled to take place, beginning in 2026.
- Manned shuttle mission are scheduled to begin in 2029 according to Musk.
-
- 2031 is a more realistic goal for manned missions.
- The goal is to beginning the construction of a self sustaining city in 20 years.

"The goal to maintain the lifespan of consciousness will increase if the human race can become multiplanetary" - Elon Musk (X Post, 2025)

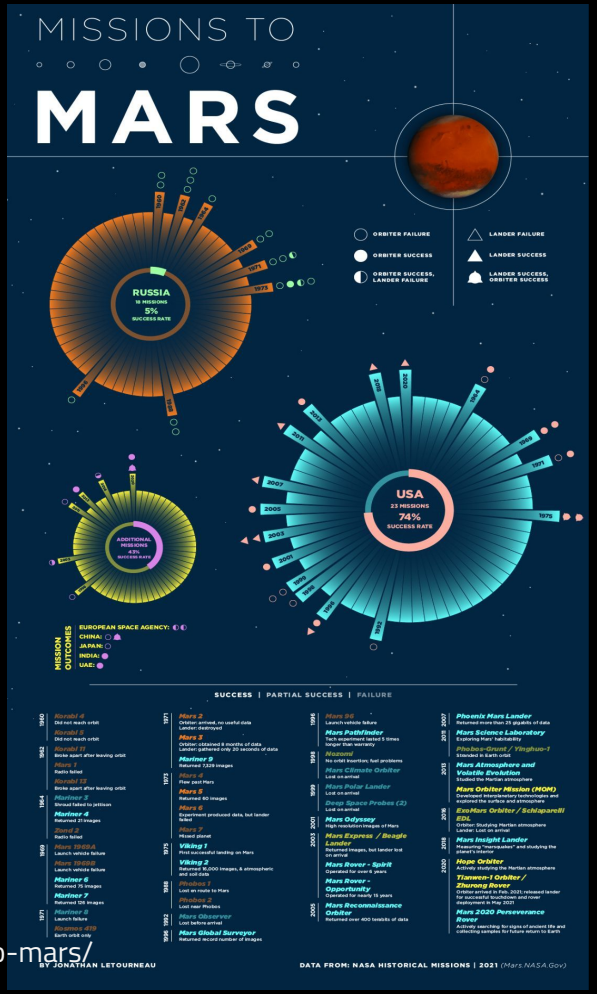


Figure 12. Missions to Mars, retrieved from https://www.visualcapitalist.com/cp/every-mission-to-mars/

Travel Plan

- Starship launches from Spaceport and ascends to Low Earth orbit
- Refuel with Tanker Spacecraft
- Minimal fuel used on descent to Mars due to aerobraking
- Begin process of establishing Mars as a base through use of Optimus
- Refuel through ISRU and depart

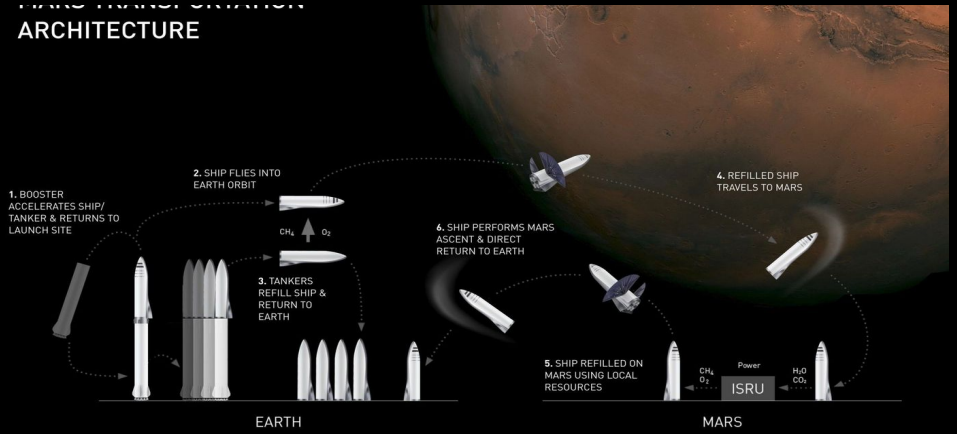


Figure 13. Mars Transportation Architecture, retrieved from https://www.humanmars.net/p/mars-base-alpha.html

Figure 14. Elon, Retrieved from https://www.thehansindia.com/technology/tech-news/elon-musk-assures-humans-to-travel-to-mars-in-next-5-to-10-years-722357

Technology Advancements for Mars

01 Optimus

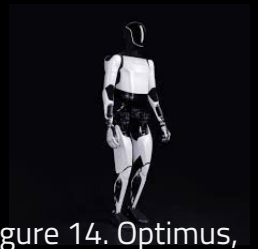


Figure 14. Optimus,

Tesla's new humanoid robot

02 Tanker Spacecraft

SpaceX's idea to refuel Starship after launch

Figure 15. Space Tankers

03 In Situ Resource Utilization (ISRU)

The possibility to utilize resources on Mars to refuel Starship.

$CO_2 + 2\ H_2O \rightarrow CH_4 + 2\ O_2$

04 Extravehicular Activity Suit (EVA)

A rapidly progressing design of new space suits

Challenges For SpaceX on Mars

Costs

The costs would likely exceed trillions of dollars

Life Support

Functioning life support and energy generation

Health Concerns

Unknown components of Mars could lead to health complications

Tanker's

There hasn't been any confirmed trials of tankers for refuel

Ethical concerns

Do we terraform, who runs Mars, what are the implications?

Launch Windows

Launch windows open every 26 months

Is Mars realistic currently?

Figure 16. Mars

Time Lines

The timelines placed by SpaceX are currently unrealistic with current technology and data.

Feasibility of Return Flights

The return flight to LMO is 72% above a realistic velocity budget

Technology Readiness

Currently the technology is not available for long term sustained missions to Mars.

Payloads

SpaceX has not released realistic payloads for manned expeditions on Starship. Realistic loads would far exceed its capacity at this time.

04

Ethical, Financial, and industry impact Of Private Sector

Challenges of Private Space Travel

Cost, Regulation, and Accessibility

- High costs limit accessibility
- Complex and evolving regulations
- Ethical concerns: exclusivity & commercialization

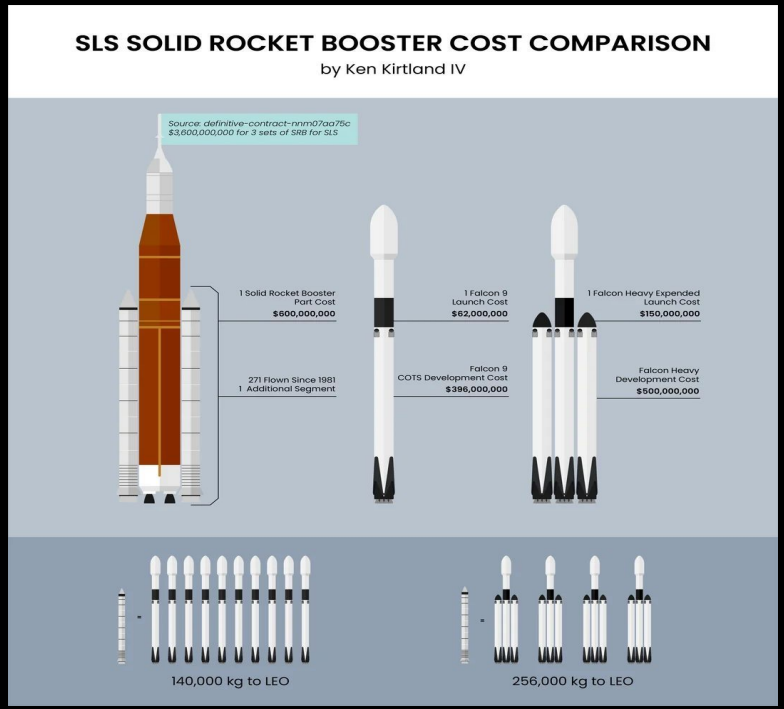


Figure 17. SLS and Falcon Infographic (Reddit, 2019)

SpaceX's Disruption of the Traditional Space Industry

A Game-Changer

Figure 18. Falcon 9 (SpaceX, 2020)

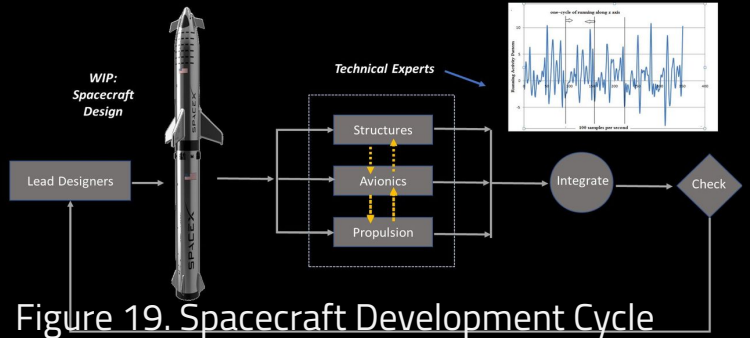


Figure 19. Spacecraft Development Cycle (Harvard, 2021)

Figure 20. Boeing (NYSE, 2019)

Reusable rockets = dramatically lower costs

Faster innovation cycles than government agencies

Pressure on traditional aerospace companies (e.g., Boeing, Lockheed)

Public vs. Private Roles in Future Exploration

Who Leads the Next Era?

1. Governments: science, long-term missions, safety
2. Private companies: innovation, efficiency, tourism
3. Collaboration is key (e.g., NASA + SpaceX partnerships)

Figure 21. Jim Bridenstine and Elon Musk (Business Insider, 2019)

Ethical & Financial Implications

Ethics, Equity & Economics

- Wealth gap highlighted in space tourism
- Environmental concerns from launches
- Economic potential: jobs, tech spinoffs

Figure 22. Astronaut in space (Getty Images, 2025)

Industry Trends and Funding Comparisons

Space Industry Snapshot

- Global space economy: $500+ billion in 2023
- Private investment growing faster than public
- U.S. leads, but global players rising

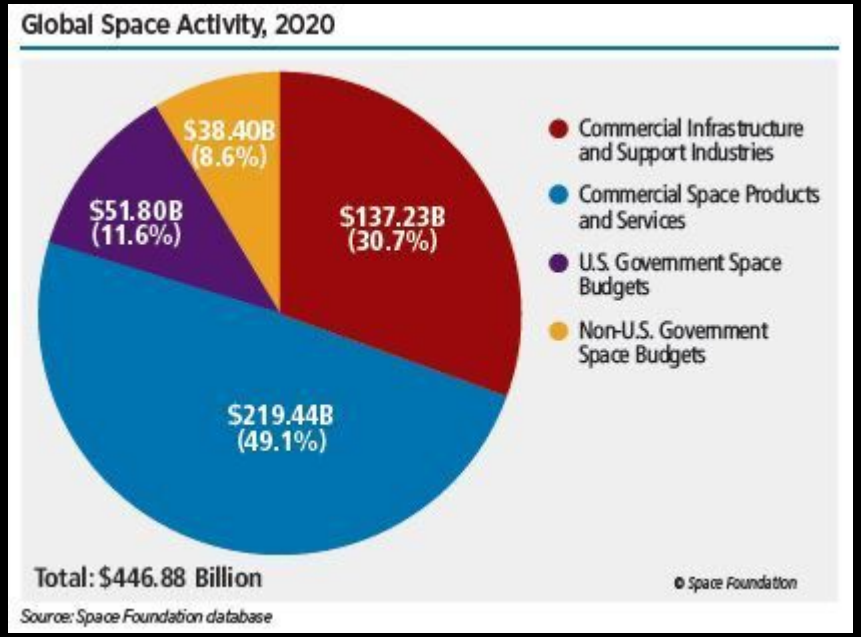


Figure 23. Global Space Activity (Space Foundation Database, 2020)