

**An Investigation in Whether or Not the Artemis Space Program to Reach the Moon Is
Worth the Costs**

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On my honor as a University Student, I have neither given nor received unauthorized aid on this
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Introduction: Is The Artemis Program Worth It?

In September 1962, President John F. Kennedy set the precedent for the future of space exploration with his words, “We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard” (John F. Kennedy, n.d.). From that point on, the National Aeronautics and Space Administration (NASA) took the helm, reaching the moon within the decade, launching the first Space Shuttle four years after beginning design (Space Shuttle, n.d.), and sending the first module of the International Space Station into low Earth orbit (LEO) (ISS, n.d.), all before the 21st century.

Over 50 years later, NASA has barely left Low Earth Orbit (LEO) and relies solely on Space-X and Russian Soyuz to explore space. The Artemis program seeks to fill this void, fostering economic stimulation and deep space exploration (NASA, 2025). However, with the Department of Government Efficiency slashing budgets and the program being delayed for the second time to 2027, the reality of success is in question. As an example, we look to the past and present to compare the capabilities and costs of reaching the moon and beyond. The Space Launch System (SLS), is two thirds the price, but can take just over half the payload to LEO as compared to the Saturn V. Compared to commercial endeavours the Starship is significantly cheaper than the SLS and has similar, but better capabilities to the Saturn V as seen in Figure 1 (Kordina, 2020).

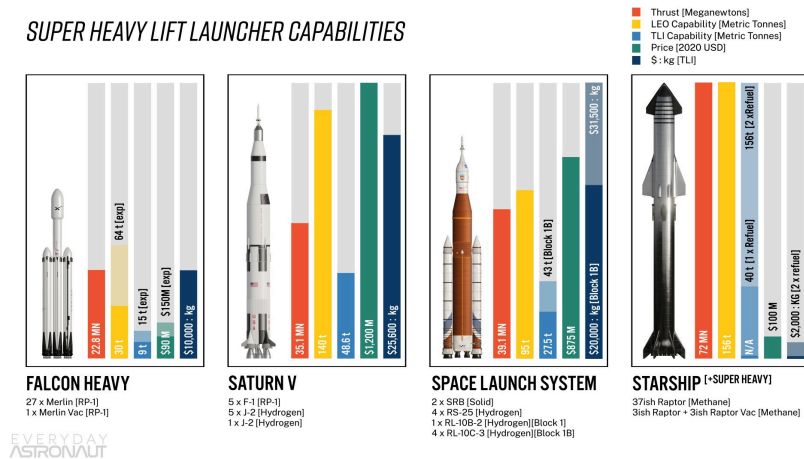


Figure 1. SLS vs Starship Heavy Lift Launcher Comparisons

As with any government contract NASA should be “addressing any issues arising during contract performance that might increase performance risk” (Department, n.d.). To ensure the success of this program, it is crucial to evaluate the mission objectives related to economic development and operational profiles. Gaining firsthand experience in the design and testing of a sub-scale sounding rocket enhances understanding of the foundational design principles and sacrifices involved in space exploration. This experience ultimately contributes to discussions about the value of NASA’s Artemis Space Program. Through both a technical and societal analysis of the Artemis program, the value of this path toward space exploration can be fully assessed.

Methodology

This research paper examines the economic and mission-related risks of the Artemis program through both a quantitative and qualitative lens, while utilizing a sociotechnical framework to assess its broader impacts. This methodology dissects secondary sources, like the Government Accountability Office and other relevant literature. By comparing and contrasting the benefits and drawbacks of the Artemis program, this study can evaluate the overall value it has on humanity. This approach provides the opportunity to reflect on the past and present,

solidifying our ability to avoid repeating the same mistakes, and comparing the value to current competition. Furthermore, this paper investigates the differences so that niche issues can be addressed and the success of future space exploration missions can be optimized.

Discussion

Stakeholders are critical to every engineering design and determining the impacts on them and reducing the negative consequences on them is the responsibility of engineers for the greater good of society. The NASA Artemis Space Program was started in 2017 and reached its first successful test launch in 2022, which was initially scheduled for 2018 (Artemis Programme, n.d.). From the beginning, delays like this create questions on whether or not NASA is making the responsible decision for its stakeholders with the Artemis program. These decisions have widespread impacts, from the European Space Agency to Axiom and many other partners across the globe. This will not only impact employees and taxpayers as NASA has stated “every state in America has made a contribution to the success of NASA’s Artemis program (NASA, 2025), but it will also affect the lives of astronauts and other future impacts like the environment. As the Department of Government Efficiencies seeks to weed out waste, determining whether or not the Artemis program is the utilitarian ethical decision for its stakeholders of society is critical.

The Artemis program offers many benefits, but the high costs and tradeoffs make it seem like a risky decision. NASA has not yet provided a preliminary cost estimate, despite recommendations since December 2019 (Russell, 2024). This uncertainty stems from transitioning components from the Constellation program to Artemis, which raises concerns about potential losses for taxpayers and Congress. While costs remain uncertain, NASA’s Inspector General reports that up to FY25, the program has spent \$93 billion, with each Artemis SLS rocket projected to cost \$4.1 billion (Office of Inspector General, 2021). A key issue is the

reuse of expensive RS-25 engines from the Space Shuttle program, which adds to the financial burden when each \$4.1 billion rocket is discarded. Despite these financial challenges, there are advantages to Artemis. Reusing components like the RS-25 engines and Orion capsule has helped reduce costs (Kordina, 2020). Additionally, NASA used a fixed-price contract for the Lunar Lander, shifting some cost risks to private industry and ensuring stable pricing (Kordina, 2022). Artemis has also had a positive economic impact, generating \$20 billion and creating 37,000 jobs nationwide (Kluger, 2022). This economic boost helps support engineers and workers, making the program's benefits tangible for the public despite its high costs. Furthermore, it has facilitated the transition of Space Shuttle jobs, preserving vital expertise for future missions. With the uncertainty of Artemis programs' shift of risk to the public, the parallels to past context and precedent need to be considered.

Through programs such as the Apollo space program or the Space Shuttle program their impacts on stakeholders shaped public and governmental support. The Apollo program was seen originally as a cold war endeavor, with the European Commission stating that “public commitment with the space race was oriented and fostered to maintain the balance of power and spheres of influence” (Arrilucea, 2023). The case study proceeds to discuss that the high cost and the ending of the space race led federal and social initiatives and developments to fail. This made the project less interesting to political leaders that were advocates for it originally, ultimately ending it after time. The Artemis program is already almost a third of the Apollo program's budget with only one successful launch, as well as there being no major event to give the public and government the drive to complete it. While the Space Race displays the immediate concerns for the Artemis program, the Space Shuttle dives into the long term risks. Over the course of the Space Shuttle program each rocket launch was approximately \$1.5 Billion and launch rates were

4.7 times a year, however the predicted calculations were \$800 Million and 8 flights a year as Roger Pielke stated. This program was meant to be affordable with the reusability aspect, however it ended up being the most costly space program to that date. The aspect of not reusing spacecraft with the Artemis program allows for a reduction in development costs and simplicity in operation and design. However, with each launch of an SLS being 4 times the cost of one space shuttle launch, and there having been only 1 launch in the past 8 years the tradeoff in longevity for simplicity might be racking up the bill. The Artemis program has several objectives to better the system of space exploration and open the gateway to reaching the Moon and beyond, however the current path it is taking appears to not have the needed development that past programs have.

The Artemis program aims to return to the Moon, build the Gateway space station, establish a permanent lunar base, and eventually reach Mars. These objectives carry both benefits and risks. NASA highlights the mission's importance, stating, "while maintaining American leadership in exploration, we will build a global alliance and explore deep space for the benefit of all" (NASA, 2024). This goal is especially crucial as the U.S. competes with China for space dominance, after losing its lead with the Space Shuttle's end in 2011. Two key components driving Artemis are the Near Rectilinear Halo Orbit (NRHO) and the Gateway station. The NRHO offers a stable, efficient orbit, ensuring constant Earth visibility and serving as a platform for future missions (The Lunacy, n.d.). The Gateway allows for refueling and serves as a staging point for astronauts, while also stimulating private industry. These components benefit various stakeholders, including astronauts, industry professionals, and scientists. However, they also come with significant risks. The NRHO poses a challenge for abort scenarios, where a "stricken lander might take days to catch up with the orbiting Orion,

risking human lives” (The Lunacy, n.d.). Similarly, docking with the Gateway introduces another point of failure, further endangering astronauts. These risks raise concerns about astronaut safety and could harm public perception of NASA and space exploration.

While the societal impacts were addressed based on an analysis of economics and mission parameters, these risks are shifted through political and global changes. With President Trump’s 2nd term introducing the Department of Government Efficiencies (DOGE), how has this department created immediate and lasting effects on the Artemis program, NASA as a whole, and the future of space exploration. Alyssa Lafluer from Space Insider brings up the issues “over contract reviews, employee buyouts, and Musk’s dual role as both a federal official and the CEO of SpaceX”, which all must be looked at in order to determine the most ethical outcome for society. With a piece of the Artemis program already contracted out to SpaceX, the Human Landing System (HLS) specifically, how much more could be shifted towards the privatized sector with the immense budget, lack of clarity, and shift in goals. The cost per SLS is significantly higher than the \$100 million per Starship rocket (Kordina, 2020), a 41:1 price difference for similar missions, with the SLS being \$4.1 Billion per rocket. NASA has also had success with these partners, with the Axiom spacesuit reaching the preliminary design review, and SpaceX has had 4 successful launches according to (GAO, 2025). This shift in an era of NASA dominated space flight to commercial space flight dominance could be closer than we think as the Axiom space station is on the horizon with support from NASA’s contract relieving the ISS (NASA, 2024). Lastly, the development in our own country cannot hide the efforts from those around the globe. Comparing the development of Artemis to other countries like China’s Chang’E lunar program provides a critical assessment of our progress. China’s Chang’E lunar program has steadily progressed with lower public costs and a more transparent development

timeline. Specifically, the China Lunar Exploration Program (CLEP) has utilized robotics to develop a station on the far side of the moon, and has met the objectives of in-situ resource utilization, telecommunication relays, and lunar samples according to (XU et al., 2018). The CLEP has had 6 missions achieving the previous objectives compared to NASA Artemis's 1 successful launch. While the mission profiles of robotics versus humans leads to different developments, the timeline from CLEP has been on a better schedule and shown that there is competition for a capable presence on the Moon, and for future exploration on Mars and beyond. While the Artemis program remains a vital and ambitious step toward sustained US presence beyond Earth, its long-term viability depends on recalibrating its goals, governance, and partnerships to align more closely with ethical imperatives, fiscal realities, and global progress in space exploration.

Conclusion

The NASA Artemis Space Program stands at the forefront of modern space exploration and represents a defining effort in humanity's return to the Moon—and beyond. Its global influence extends beyond scientific and technological boundaries, shaping international partnerships, national prestige, and the future of aerospace careers. As our capstone team designed and developed our own sub-scale sounding rocket, Artemis served as both an inspiration and a benchmark. Its complexity, costs, and innovative partnerships demand critical reflection on stakeholder impact, fiscal responsibility, and ethical decision-making. Despite high costs and a risky concept of operations, Artemis has demonstrated notable successes in collaborating with commercial companies, revitalizing the aerospace economy, and preserving essential workforce expertise. These developments are not just economic—they represent the

evolution of space exploration strategy, where public agencies and private enterprises must work together to push humanity further into deep space. These partnerships have the power to advance scientific research, create economic opportunities, and establish a sustainable human presence beyond Earth—possibilities once thought unimaginable.

However, the program's benefits are not without challenges. The delays and lack of progress raise serious concerns about the program's trajectory and long-term viability. NASA's actions, while well-intentioned, must be assessed not only by their outcomes but also by the ethics of their decision-making processes. Are the agency's actions inherently ethical simply because they serve a noble cause, or do transparency, accountability, and stakeholder inclusion define that morality? NASA should consider if the decision to regularly dispose of a \$4.1 billion SLS rocket every launch a worthwhile effort for innovation without even knowing the budget of the overall mission? The Artemis program has indeed fostered a renewed culture of scientific excellence and public service—preserving jobs, inspiring students, and rekindling public interest in space. Yet, this culture risks being undermined if budget overruns, unclear timelines, and shifting goals go unaddressed. As costs escalate and private companies like SpaceX continue to deliver lower-cost alternatives, Artemis must prove it can adapt. The program's long-term success depends on its ability to remain flexible in the face of growing fiscal constraints and a rapidly evolving commercial space sector.

Moreover, Artemis is more than a space mission—it is a societal endeavor aligning ethical standards, public priorities, and global cooperation. The impacts of Artemis are undeniably mixed. On one hand, it represents a bold leap for mankind; on the other, it risks becoming a financial and logistical disaster if not carefully managed. Transparency in spending, clearly defined milestones, and public communication are essential to maintaining public trust

and justifying the vast expenditures involved. Without these, even the most ambitious goals may falter. Ultimately, the question remains: Is Artemis a stepping stone to Mars and interplanetary human expansion, or a potential dead-end due to outdated infrastructure and bureaucratic inertia? The answer depends on NASA's willingness to reassess its strategies, embrace innovation, and prioritize the greater good over institutional tradition. At the time of finalizing this thesis, the current administration proposed budget cuts depicted in Figure 2, aligning with the reform of the Artemis towards cutting/reshaping the SLS and Gateway risks towards better space exploration developments (Stevens, 2025).

Program Name	\$ Change from 2025 Enacted (in millions)	Brief Description of Program and Recommended Reduction or Increase
National Aeronautics and Space Administration (NASA)		
<i>Increases</i>		
Human Space Exploration	+647	By allocating over \$7 billion for lunar exploration and introducing \$1 billion in new investments for Mars-focused programs, the Budget ensures that America's human space exploration efforts remain unparalleled, innovative, and efficient.
<i>Cuts, Reductions, and Consolidations</i>		
Space Science	-2,265	In line with the Administration's objectives of returning to the Moon before China and putting a man on Mars, the Budget would reduce lower priority research and terminate unaffordable missions such as the Mars Sample Return mission that is grossly overbudget and whose goals would be achieved by human missions to Mars. The mission is not scheduled to return samples until the 2030s.
Mission Support	-1,134	The Budget refocuses NASA on beating China back to the Moon and putting the first human on Mars. To achieve these objectives, it would streamline the workforce, IT services, NASA Center operations, facility maintenance, and construction and environmental compliance activities.
Earth Science	-1,161	The Budget eliminates funding for low-priority climate monitoring satellites and restructures the gold-plated, two-billion-dollar Landsat Next mission while NASA studies more affordable ways to maintain the continuity of Landsat imagery, which is used by natural resource managers, States, and industry.
Legacy Human Exploration Systems	-879	The Budget phases out the grossly expensive and delayed Space Launch System (SLS) rocket and Orion capsule after three flights. SLS alone costs \$4 billion per launch and is 140 percent over budget. The Budget funds a program to replace SLS and Orion flights to the Moon with more cost-effective commercial systems that would support more ambitious subsequent lunar missions. The Budget also proposes to terminate the Gateway, a small lunar space station in development with international partners, which would have been used to support future SLS and Orion missions.
Space Technology	-531	The Budget reduces Space Technology by approximately half, including eliminating failing space propulsion projects. The reductions also scale back or eliminate technology projects that are not needed by NASA or are better suited to private sector research and development.

Figure 2. Fiscal Year 2026 Discretionary Budget Request NASA

Ultimately, while the Artemis program is a monumental and potentially transformative endeavor, it must evolve to meet the challenges of a new space era. Despite its flaws, the collaboration with private industry, the preservation of skilled labor, and the economic benefits signal meaningful progress. Still, reform is essential. If NASA can align its goals with ethical

accountability, stakeholder value, and strategic flexibility, Artemis will not just mark a return to the Moon—it will serve as a sustainable foundation for humanity's next great leap. Now is the time to act decisively, to ensure Artemis becomes not just a symbol of ambition, but a model of ethical and effective space exploration.

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