Why do humans pursue space exploration?

Humans pursue space exploration for five basic reasons. The first emphasizes science, the second reason concerns national defense.

Defense officials consume a large portion of their government's overall space budget. In the United States, the federal government spends far more on defense related rockets, missiles, satellites, and associated space-age command and control systems than NASA spends on space science. Little wonder that exploration enthusiasts are periodically attracted to defense entities as a source of support for the technologies that further their work – and sometimes get it. If the science budget is meant to enlarge knowledge, the space defense budget projects force.

For at least two thousand years, defense strategists have taught soldiers that they need to occupy battlefield positions that constitute the military "high ground." During the American civil war, Union forces (and confederates too) attached platforms to reenforced balloons and used them to observe opposing troops and the location of enemy artillery.[1] Military personnel on both sides of World War I purchased aero planes that conducted reconnaissance patrols over enemy-held territory. Shortly thereafter, pilots received weapons to defend themselves from opposing aviators, ushering in the era of air combat.

In 1952, in a widely read article in Collier's magazine, German rocketeer and American space travel advocate Wernher von Braun pressed his adopted country to construct an Earth orbiting space station. Among its many capabilities, von Braun prophesized, the large orbital facility would serve as a reconnaissance platform. "It will be almost impossible for any nation to hide warlike preparations for any length of time," he said.[2]

Nations with large military forces invested heavily in rockets and missiles. The rocket extended the scope of war at the same time rocket-launched reconnaissance satellites checked the likelihood of a sudden attack.

Astronomers, science fiction fans, rocket club members, and other promoters of space exploration recognized a salient feature of these developments. The one group with the motivation to fund the enterprise and the money to do it was the military. National security is a primary responsibility of the state, and access to space was the modern way to secure it. "Control of space meant control of the Earth," space exploration advocates frequently proclaimed.[3]

Consequently, military rocketry became closely intertwined with civil space flight. The US Army Ballistic Missile Agency (ABMA) competed tightly with the US Naval Research Laboratory for the task of launching the first US space satellite. Yuri Gagarin, the first human to

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[1] American Battlefield Trust, "Civil War Ballooning." www.battlefields.org (2022) accessed October 1, 2022).

[2] Wernher von Braun, "Crossing the Last Frontier," *Collier's* (March 22, 1952) 26. See also Michael Neufeld, *Von Braun: Dreamer of Space, Engineer of War."* New York: Knopf, 2007.

[3] Howard E. McCurdy, *Space and the American Imagination*. Baltimore: Johns Hopkins University Press, rev. ed, 2011: 73-75, 83-84.

orbit the Earth, flew into space on a modified R-7 Soviet intercontinental ballistic missile (ICBM). American astronaut John Glenn followed on an Atlas ICBM redesigned for human flight.

To create the huge Saturn-V rocket that propelled American astronauts to the Moon, Congress transferred the ABMA and its team of expatriate German rocketeers from the U.S. Army to the newly formed NASA. To help NASA researchers scale up for the Moon race, agency executives recruited individuals familiar with the techniques of large-scale systems management used by the US Air Force to develop missiles.

Soviet officials likewise made use of German scientists and V-2 rockets captured at the Peenemunde rocket works. Captured V-2s became Soviet R-7s which in turn led to the deployable R-7A intercontinental ballistic missile. Soviet engineers then used the R-7 rocket to launch the first Earth-orbiting satellites, Sputnik 1 and 2.

Back in the United States, President Dwight Eisenhower insisted that Congress create a statutory wall of separation between military and civil space activities. This became NASA. The wall separated rocket enthusiasts and their relentless agitation for human expeditions to the Moon and Mars from funding sources in the military. Eisenhower worried that the human flight faction if given too much authority would drain off funds needed for defense-specific space activities, particularly reconnaissance satellites that could reveal what Soviet engineers were doing behind their descending iron curtain.

An independent American space agency also provided cover for US military space activities. The Eisenhower administration's 1959 Aeronautics and Space Activities report to the Congress blandly stated that the government planned to spend funds developing a "capsule recovery operation" for what the report described as a Discoverer satellite. The language artfully disguised the true purpose of the top-priority project – development of the nation's first Corona reconnaissance satellite. The project allowed the United States to take photographs of Soviet activities from space, eject the film cannister, and place the descending cannister and parachute in the path of a skyhook aircraft.[4] The Eisenhower administration had initiated the project in 1956 following the Soviet Union's rejection of Eisenhower's "open skies" proposal of aircraft overflights. Overseen jointly by the US Air Force and the Central Intelligence Agency, project workers tested the first Corona satellite in 1960.

The Soviet Union and later the People's Republic of China followed their own pathways to separation. Soviet leaders authorized a collection of design bureaus to race the United States to the Moon, assuring all that none would receive the resources necessary to accomplish their tasks. A separate design bureau under the leadership of Sergei Korolev developed a massive N1 rocket that never worked, exploding four times. The bureaus were separate enough to prevent raids on the defense establishment for badly needed funds, but close enough for defense leaders to keep the bureaus in check. Preoccupied with the development of ballistic missiles, Soviet military leaders saw little value in building huge rockets aimed at the Moon. Organizational arrangements shifted frequently as the Soviet space program matured,

[4] President of the United States, report to Congress, U.S. Aeronautics and Space Activities, January 1 to December 31, 1959: 23. Copies of the annual reports can be obtained through history.nasa.gov.

sometimes part of the military, at other times organizationally independent.[5] A few decades later, Chinese leaders provided a degree of military-civil separation by placing their national space administration program under the ministry responsible for industry and information technology. They then added an additional level of separation by establishing a separate agency for manned space flight.

Separation policies served to create an outward impression of equity between civil and military space activities. Beginning in 1959, the US federal government has prepared an annual report describing its aeronautics and space activities. In the years between 1959 and 2022, reported civil spending exceeded military spending 44 times; military spending exceeded civil 36 times. Civil space (NASA) ran ahead during the Apollo years; reported defense spending exceeded civil space after President Ronald Reagan announced his support for a strategic missile defense initiative. The two columns shifted positions again as administrations changed and the United States contemplated a return to the Moon and a human expedition to Mars.[6]

Featured defense activities in the 2022 report included high frequency communication satellites, navigation satellites (GPS), weather satellites, missile tracking satellites, rocket launches, and aircraft development. Yet these activities constitute only a small proportion of the space age activities upon which the US defense establishment can draw.

The 2022 annual aeronautics and space report highlighted defense space activities totaling $15.5 billion, less than the $23.2 billion assigned to NASA space activities. Yet when asked to count the scale of defense activities in space for presentation in the defense department's "green book" of budget estimates, the defense department comptroller identified $22.7 billion – more than in the aeronautics and space report. The green book figure did not consolidate Defense Department spending on long-range rockets and missiles – what are known as strategic forces – with space activities. That would add $19.4 billion. The defense department's space-age command, control, and communication activities are highly space dependent and likewise candidates for inclusion, but likewise excluded. In 2022 the budget for command, control, and communications totaled $99.2 billion.[7]

[5] See Roger D. Launius, Reaching for the Moon: A Short History of the Space Race: Yale University Press, 2019.
[6] Aeronautics and Space Report of the President, Fiscal Year 2021 and 2022 Activities, Appendix D-1A:338-39.
[7] Office of the Undersecretary of Defense (Comptroller), National Defense Budget Estimates for 2024 (Green Book), May 2023, table 6-4: Department of Defense TOA by Major Force Program: 104-105. https://comptroller.defense.gov/portals/45/documents/defbudget/fy2024/fy24_green_book.pdf. See also, US Department of Defense, C3 Modernization Strategy, nd <dodcio.defense.gov/Portals/0/Documents/DoD-C3-Strategy.pdf> (accessed June 30, 2023).

Table 1.
Budget authority, US Department of Defense Green Book, fiscal year 2022. Billions of dollars.

Budget Authority	Budget (Billion$)
Defense department space activities	22.7
Strategic forces	19.4
C3, Intel & Space	99.2
Total	141.3
Remaining defense budget	628.2
NASA (total budget authority, 2022, space only)	23.2

Source: US Department of Defense, see footnote 7.

The size of the US Defense Department's budget for space varies with the activities one chooses to include. The number can be well above the whole NASA authorization and testifies to the degree to which modern warfare depends upon space related systems.

An increasing number of space age activities occupy a special position on the list of justifications. They are "dual use" technologies. These items have relatively inseparable characteristics that make them useful for both scientific and security concerns.

The cryogenic upper stage RL-10 rocket engine that the US defense department planned to use to launch its military communication satellites utilized the same propellant technology as the J-2 rocket engines that lifted US astronauts toward the Moon. Astronomers placed gamma ray detectors on large space telescopes to detect the death throes of very large stars. The detectors used the same technology as Vela satellites placed in space to scan the Earth for the characteristic double flash of an atmospheric nuclear weapons test, permitting verification of the 1963 Limited Test Ban Treaty. Although the design solutions seemed to be quite different, the technical knowledge gained from building US KH-11 spy satellites appears to have informed the technology needed to create the Hubble Space Telescope. Many of the same aerospace companies were involved.

When the defense establishment agrees with the science or human space flight communities that a particular technology serves national security needs, it creates a powerful coalition that is nearly impossible to deny.

In 2019 the United States created a US Space Force to coordinate national defense space policy, emphasize the value of space assets, and elevate outer space as a realm equal in importance to land, sea, and air. The organizational ascendancy once again testified to the importance of national defense as a justification for spending money on space.

Dr. Howard McCurdy, July 2023