COMMITTEE ON
SCIENCE, SPACE AND TECHNOLOGY
CHAIRMAN BRIAN BABIN

SUBCOMMITTEE ON SPACE & AERONAUTICS

HEARING CHARTER

Leveraging Commercial Innovation for Lunar Exploration: A Review of NASA's CLPS Initiative

Tuesday, April 1, 2025
10:00 A.M.
2318 Rayburn House Office Building

Purpose

The purpose of this hearing is to evaluate NASA's Commercial Lunar Payload Services (CLPS) program. This hearing will consider the structure and outcomes of the program, including its unique approach towards risk, often referred to as a "shots on goal" approach. The hearing will consider whether the CLPS missions conducted thus far have met the original intent of the program, if there are ways the CLPS program can be improved moving forward, and how CLPS can inform future collaborative efforts between NASA and the private sector. Finally, it will offer an opportunity for CLPS providers to share their experiences with Congress.

Witnesses

- **Dr. Nicola Fox**, Associate Administrator, Science Mission Directorate, National Aeronautics and Space Administration
- **Dr. Brett W. Denevi**, Principal Staff Scientist, Johns Hopkins Applied Physics Laboratory
- **Mr. John Thornton**, Chief Executive Officer, Astrobotic Technology
- **Mr. Stephen Altemus**, President and CEO, Intuitive Machines
- **Mr. Jason Kim**, Chief Executive Officer, Firefly Aerospace

Overarching Questions

- How successful has CLPS been in achieving its stated goals and objectives?
- What impact has the CLPS model had on the development of a lunar economy?

- How has the CLPS procurement approach worked out, both for the government and for providers?
- What challenges have CLPS providers experienced, and how can Congress and NASA work to alleviate them?

Background

Commercial Lunar Payload Services

NASA uses the Commercial Lunar Payload Services (CLPS) initiative to acquire delivery services for NASA-sponsored payloads to the lunar surface from commercially developed and managed lunar landers. NASA aims to leverage the initiative to gain deeper insights into the lunar environment, expand the lunar economy, and support preparations for Artemis crewed missions to the Moon.[1]

Structure

The CLPS initiative uses a 10-year indefinite delivery, indefinite quantity contract with a maximum value of $2.6 billion. NASA plans to award two firm-fixed-price task orders annually, which are competed among a pool of CLPS vendors. Selected vendors are responsible for providing end-to-end lunar delivery services, including designing and building a robotic lunar lander, integrating NASA-provided payloads, procuring launch services, and landing and operating the spacecraft on the lunar surface. [2] Since the CLPS initiative began in 2018, NASA signed contracts for 11 deliveries, taking more than 50 instruments to the lunar surface.[3]

NASA's Science Mission Directorates (SMD) selects instruments for CLPS deliveries through its Payloads and Research Investigations on the Surface of the Moon (PRISM) solicitation.[4] Under a 2020 memorandum of understanding, the Space Technology Mission Directorate (STMD), Exploration Systems Development Mission Directorate (ESDMD), and Space Operations Mission Directorates (SOMD) are also eligible to submit payloads for consideration.[5] International partners can also provide payloads; NASA pays for the commercial delivery service in exchange for rights to data from the payload or participation of U.S. scientists on the international science teams.[6]

A CLPS Manifest Selection Board (which includes representatives from SMD, STMD, ESDMD, SOMD, the Office of International and Interagency Affairs, and the CLPS projects office) reviews the candidate payloads. Once the payloads have been selected, the Board allocates each

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[1] NASA. 2024. Commercial Lunar Payload Services Overview. Available at: https://www.nasa.gov/wp-content/uploads/2024/02/np-2023-12-019-jsc-clps-artemis-brochure-2024-web-2-14-24.pdf
[2] U.S. Government Accountability Office. 2022. NASA Lunar Programs: Improved Mission Guidance Needed as Artemis Complexity Grows (GAO-22-105323). Available at: https://www.gao.gov/products/gao-22-105323
[3] NASA. 2025. NASA Science Continues After Firefly's First Moon Mission Concludes. Available at: https://www.nasa.gov/news-release/nasa-science-continues-after-fireflys-first-moon-mission-concludes/
[4] NASA Office of Inspector General. 2024. NASA's Commercial Lunar Payload Services Initiative (IG-24-013). Available at: https://oig.nasa.gov/office-of-inspector-general-oig/nasas-commercial-lunar-payload-services-initiative/
[5] Id at 4
[6] NASA. 2024. FY 2025 Full Budget Request (Congressional Justification). Available at: https://www.nasa.gov/fy2025-budget-request/

payload to a flight manifest, allowing the Manifest Selection Board to develop requirements for CLPS services that will deliver that manifest to the lunar surface.

Once the payload manifest and associated requirements are finalized, the Exploration Science Strategy and Integration Office (ESSIO) and CLPS project office issue a request for proposals to the providers, collect proposals and ultimately award a task order to the selected provider.[7] Once selected, the CLPS vendor engages with the principal investigators for the selected payloads to integrate the payloads and prepare for the mission.

While NASA provides the majority of CLPS payloads, CLPS vendors are encouraged to sell capacity to non-NASA payloads.[8]

Service-Based Approach

Rather than pay for the development of a lunar lander, NASA conducts CLPS missions using commercial service-based contracts. Under CLPS, "vendors are responsible for developing new lander technologies and providing delivery of payloads to the lunar surface without NASA controlling or overseeing the contractors' designs, systems, processes, or infrastructure."[9] Providers have the flexibility to make choices for the design and operation of their lunar landers that better fit their business model and allow them to cater to customers outside of NASA.

However, the limited NASA insight and oversight of the CLPS model requires the agency to accept a higher risk level than traditional procurements. Rather than focus on risk mitigation, the CLPS initiative seeks to manage risk exposure.[10] NASA's goal is to "address risks for vendor-owned development and the potential loss of landers by (1) using instruments for initial deliveries that were low cost and non-critical, but still useful, to minimize scientific impact if instruments are lost and (2) developing small- to medium-size landers first, then progressing to larger landers for more complex payload deliveries."[11] NASA informally refers to this risk posture as taking "shots on goal."

Rationales

NASA intends for CLPS to fulfill a range of national interests. According to NASA, CLPS is "an innovative, service-based, competitive commercial acquisition approach that enables rapid, affordable, and frequent access to the lunar surface using a growing market of American commercial providers."[12]

From a scientific perspective, the program "affords planetary scientists more than just the typical one or two chances to deploy payloads during their career."[13] A high number of missions can target several different sites on the lunar surface, enabling a variety of lunar exploration

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[7] National Academies of Sciences, Engineering, and Medicine. 2021. Report Series: Committee on Biological and Physical Sciences in Space: Using Commercial Lunar Payload Services (CLPS) to Achieve Lunar Biological and Physical Science Objectives: Proceedings of a Workshop. Avaliable at: https://doi.org/10.17226/26378
[8] NASA. Commercial Lunar Payload Services. Available at: https://www.nasa.gov/reference/commercial-lunar-payload-services/
[9] Id at 4
[10] Id at 4
[11] Id at 4
[12] Id at 4
[13] Id at 4

activities, including the search for lunar water ice.[14] NASA views the program as a tool to "deepen our understanding of the Moon to prepare for humanity's long-duration stays on the lunar surface, and later, Mars."[15] CLPS can also aid in laying the groundwork for NASA's future Artemis missions. CLPS missions will "inform the development of future landers and other exploration systems needed for human lunar surface exploration."[16] According to NASA's FY25 Budget Request, "[t]his innovative approach for soliciting science investigations and technology demonstration payloads for future deliveries by CLPS providers will enable decadal-caliber science at the Moon and support the Artemis campaign."[17]

NASA also envisions the CLPS model as a pathway to "expand the lunar economy and build a marketplace on the Moon."[18] NASA seeks to become one of several customers for lunar landing services.[19] Affordable access to the lunar surface will support the development of a lunar economy and contribute to a sustained American lunar presence.

Evolution

NASA expects that the services available through CLPS will expand and evolve in response to NASA demands and future market forces. As NASA attempts to answer more complex questions through CLPS, more capable landers will likely be required. Future CLPS landers may "include such things as the ability to survive and operate through the lunar night, increased delivery mass and volume, delivery into a lunar orbit, and return services."[20] To manage risk, initial CLPS missions will use smaller landers "for risk-reduction demonstrations to help evolve lander capabilities and capacities, and inform larger, human-class lander development."[21]

Overview of CLPS Providers and Missions

NASA announced the CLPS initiative in November 2018, declaring an intent to award two task orders annually. NASA selected nine U.S. companies as vendors eligible to bid on individual CLPS task orders. The chosen vendors included Astrobotic Technology, Inc.; Deep Space Systems; Draper; Firefly Aerospace, Inc.; Intuitive Machines; Lockheed Martin Space; Masten Space Systems, Inc.; Moon Express; and Orbit Beyond.[22] The following year, in November 2019, NASA announced the selection of five additional CLPS vendors, including: Blue Origin; Ceres Robotics; Sierra Nevada Corporation; SpaceX; and Tyvak Nano-Satellite Systems, Inc.[23]

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[14] Jack Kuhr and Mo Islam. 2024. Payload Research: The Ultra Low-Cost Economics of NASA's CLPS Lunar Program. Available at: https://payloadspace.com/payload-research-the-ultra-low-cost-economics-of-nasas-clps-lunar-program/
[15] Id at 6
[16] Id at 2
[17] Id. at 6
[18] NASA. 2023. CLPS Intuitive Machines IM-1 Mission Press Kit. Available at: https://www.nasa.gov/wp-content/uploads/2024/01/np-2023-12-016-jsc-clps-im-press-kit-web-508.pdf
[19] Id at 6
[20] Id at 7
[21] Greg Chavers, Et al. 2019. NASA's Human Lunar Landing Strategy. Available at: https://ntrs.nasa.gov/api/citations/20190032452/downloads/20190032452.pdf
[22] NASA. 2018. NASA Announces New Partnerships for Commercial Lunar Payload Delivery Services. Available at: https://www.nasa.gov/news-release/nasa-announces-new-partnerships-for-commercial-lunar-payload-delivery-services/
[23] NASA. 2019. New Companies Join Growing Ranks of NASA Partners for Artemis Program. Available at: https://www.nasa.gov/news-release/new-companies-join-growing-ranks-of-nasa-partners-for-artemis-program/

In 2022, Masten Space Systems, who had been issued a task order, filed for bankruptcy; Astrobotic Technology acquired its assets.[24] The current pool of eligible vendors consists of 13 vendors, five of which have received task orders.

In 2019, NASA selected Astrobotic and Intuitive Machines as the first two vendors for CLPS missions.[25] Astrobotic's Peregrine Mission-1 launched on January 8, 2024, carrying five NASA science payloads; due to a propulsion anomaly, the mission could not land on the Moon.[26] The following month, on February 15, 2024, Intuitive Machines launched its Nova-C lunar lander with six NASA science payloads. The spacecraft landed on the Moon and began to transmit scientific data but ended the mission early when the spacecraft powered down after not receiving sufficient sunlight.[27]

In 2020, NASA awarded two task orders to CLPS providers. In June, NASA selected Astrobotic to use its Griffin lander to deliver NASA's Volatiles Investigating Polar Exploration Rover (VIPER). However, in July 2024, NASA proposed cancelling the development of VIPER, citing cost increases, delays to the launch date, and the risk of future cost growth.[28] Astrobotic is still on contract to perform the mission and will replace VIPER with other payloads; the launch is scheduled for the fall of 2025. In October, NASA selected Intuitive Machines to deliver the Polar Resources Ice Mining Experiment-1 (PRIME-1) on the company's Nova-C lander.[29] This mission launched on February 27, 2025. The spacecraft landed on the Moon and tipped over; while it established communications with Earth, its positioning prevented the lander from generating sufficient power to operate, causing it to cease operations.[30]

In 2021, NASA issued task orders to Firefly and Intuitive Machines. In February, NASA selected Firefly for a task order to deliver 10 NASA science payloads using the company's Blue Ghost 1 lunar lander.[31] The mission launched on January 15, 2025, and successfully completed two weeks of surface operations after landing on the Moon.[32] Additionally, in November of 2021, NASA selected Intuitive Machines for a task order to deliver four NASA science payloads on their NOVA-C lander with a planned launch date between late 2025 and early 2026.[33]

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[24] Id at 4
[25] NASA. 2019. NASA Selects First Commercial Moon Landing Services for Artemis Program. Available at: https://www.nasa.gov/news-release/nasa-selects-first-commercial-moon-landing-services-for-artemis-program/
[26] NASA. CLPS TO2-AB. Available at: https://science.nasa.gov/lunar-science/clps-deliveries/to2-astrobotic/
[27] NASA. Intuitive Machines 1 (Odysseus) Description. Available at: https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=IM-1-NOVA
[28] NASA. 2024. NASA Ends VIPER Project, Continues Moon Exploration. Available at: https://www.nasa.gov/news-release/nasa-ends-viper-project-continues-moon-exploration/
[29] NASA. 2020. NASA Selects Intuitive Machines to Land Water-Measuring Payload on the Moon. Available at: https://www.nasa.gov/news-release/nasa-selects-intuitive-machines-to-land-water-measuring-payload-on-the-moon/#:~:text=NASA%20will%20land%20the%20first%20woman%20and,Space%20Technology%20Mission%20Directorate%20(STMD)%20in%20Washington.
[30] NASA. Intuitive Machines 2 (PRIME 1) Description. Available at: https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=PRIME-1
[31] NASA. 2021. NASA Selects Firefly Aerospace for Artemis Commercial Moon Delivery in 2023. Available at: https://www.nasa.gov/news-release/nasa-selects-firefly-aerospace-for-artemis-commercial-moon-delivery-in-2023/
[32] NASA. Blue Ghost Mission 1 (Firefly) Description. Available at: https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=BLUEGHOST
[33] NASA. Intuitive Machines 3 (PRISM) Description. Available at: https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=IM-3-NOVA

Between 2022 and 2023, NASA issued two additional task orders. First, in July 2022, NASA selected Draper for a contract to deliver three NASA science payloads aboard the company's APEX 1.0 lander, which is expected to launch in 2026.[34] The following year, in March 2023, Firefly was selected for a task order to deliver two NASA science payloads along with a European Space Agency (ESA) payload aboard the Blue Ghost 2 lander, with an anticipated launch date of early 2026.[35]

In 2024, NASA issued three additional task orders. In August, NASA selected Blue Origin for a task order to fly a single payload aboard the company's first demonstration flight of its Blue Moon lander, which is expected to launch in 2025.[36] The same month, NASA also issued a task order to Intuitive Machines to deliver six payloads to the Moon in 2027 using the company's NOVA-C lander.[37] Additionally, in December, NASA selected Firefly for a task order to deliver six payloads to the Moon in 2028 using the company's Blue Ghost lander.[38]

[34] NASA. Draper Lunar Lander Description. Available at: https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=DRAPER
[35] NASA. Blue Ghost Mission 2 (Firefly) Description. Available at: https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=BLUEGHOS2
[36] Jeff Foust. 2024. NASA payload to fly on first Blue Origin lunar lander mission. Avaliable at: https://spacenews.com/nasa-payload-to-fly-on-first-blue-origin-lunar-lander-mission/
[37] Jeff Foust. 2024. NASA selects Intuitive Machines for south pole lunar lander mission. Available at: https://spacenews.com/nasa-selects-intuitive-machines-for-south-pole-lunar-lander-mission/
[38] Jeff Foust. 2024. Firefly wins NASA contract for third lunar lander mission. Available at: https://spacenews.com/firefly-wins-nasa-contract-for-third-lunar-lander-mission/

The following provides an overview of the landing sites for both completed and upcoming CLPS missions.

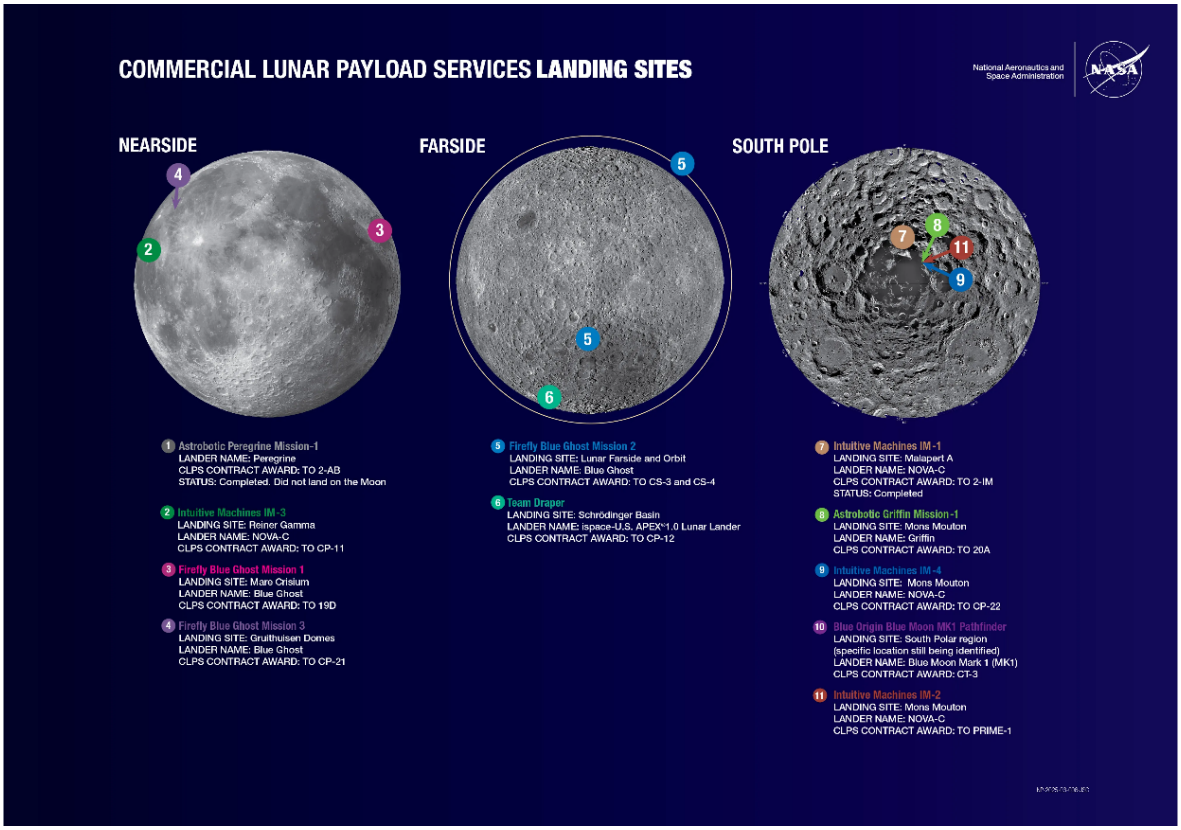

Figure 1: NASA CLPS landing sites. [Source: NASA]

Funding

The CLPS initiative consists of indefinite delivery, indefinite quantity contracts with a cumulative maximum contract value of $2.6 billion for a period between 2018 and 2028.[39] The initiative is funded under the Lunar Discovery and Exploration Program (LDEP) within SMD. In addition, the Planetary Missions Program Office (PMPO), which is independent of the CLPS project office, is responsible for the development of many of the payloads that are launched on CLPS missions. The following provides a summary of CLPS program funding.

FY 2025 Budget

Budget Authority (in $ millions)	Op Plan FY 2023	CR FY 2024	Request FY 2025	FY 2026	FY 2027	FY 2028	FY 2029
Commercial Lunar Payload Services	242.3	--	224.1	254.4	254.5	259.5	259.5

Figure 2: NASA Budget request for CLPS. [Source: NASA FY2025 Budget Request]

[39] Id. at 8

NASA OIG Report

In July 2024, the NASA Office of Inspector General (OIG) released a report auditing NASA's CLPS initiative.[40] The OIG performed the audit to assess NASA's implementation and management of CLPS and to review the extent to which the initiative has fulfilled its intended goals and objectives. The OIG made the following findings.

- CLPS challenges have resulted in an average of 14 months of schedule delay per task order and $208.2 million in cost increases across all task orders.
- NASA deviated from the CLPS model's hands-off, risk tolerant strategy and adopted more mission reliability practices and policies. As stated in the OIG report,

  "[s]pecifically, inserting a larger lander to accommodate the Volatiles Investigating Polar Exploration Rover (VIPER) into CLPS's early schedule interfered with a progressive development approach. This introduced the added risk of beginning the first large lander delivery before knowledge could be gained from the success (or failure) of smaller deliveries. NASA's planned hands-off approach was also somewhat negated when the Agency added augmented insight and placed added requirements on the vendors' development process. We found that NASA-directed changes, including augmented insight and landing site changes, led to $171.4 million in project cost increases."
- NASA's schedule for lunar landings was overly aggressive, with an average of 30 months between task order award and launch. Moreover, the choice of firm-fixed-price (FFP) contracts for CLPS was unsuitable for the initiative and didn't meet the optimal conditions for success using FFP.

Based on the report's findings, OIG made several recommendations.

- NASA SMD should conduct updated market research on the commercial lunar economy and reassess the agency's role in the commercial lunar delivery market.
- NASA's Deputy Associate Administrator for Exploration should finalize a management plan for the CLPS initiative and create a formalized charter and process for the CLPS Manifest Selection Board.
- NASA should strengthen payload requirements for CLPS to minimize changes late in the development process.

[40] Id at 4

The following figures provide additional information from the OIG's report.

Vendor (Task Order No.)	Award Date	Initial Task Order Amount ($ millions)	Current Task Order Amount ($ millions)	Cost Increase	Task Order Launch Date	Actual/Last Estimated Launch Date	Delay from Last Published Launch Date (Months)
Astrobotic (TO2-AB)	May 2019	$79.5	$107.9	35%	September 2021	January 2024	28
Intuitive Machines (TO2-IM/20C/OP)[a]	May 2019	81.7	122.0	49	September 2021	February 2024	29
Astrobotic (TO-20A)	June 2020	199.5	322.8	62	November 2023	December 2024	13
Intuitive Machines (PRIME-1)	October 2020	47.0	50.0	6	November 2022	March 2024	16
Firefly Aerospace (TO19D)	February 2021	93.3	101.5	9	September 2023	May 2024	8
Intuitive Machines (CP-11)	November 2021	77.5	77.5	–	April 2024	June 2024	2
Draper (CP-12)	July 2022	77.0	77.0	–	March 2025	March 2026	12
Firefly Aerospace (CS-3/CS-4)[b]	March 2023	129.9	129.9	–	January 2026	January 2026	–
Delivery Task Orders Total		**$781.4**	**$984.3**	**26%**		**Average Delay**	**14**
Masten Space Systems (TO19C)[c]	April 2020	75.9	81.3	7	November 2022	November 2023	–
Orbit Beyond[d]	May 2019	–	–	–	–	–	–
Total Awards		**$857.3**	**$1,065.6**				

Figure 3: Status of Current CLPS Task Orders (as of February 2024) [Source: NASA OIG]

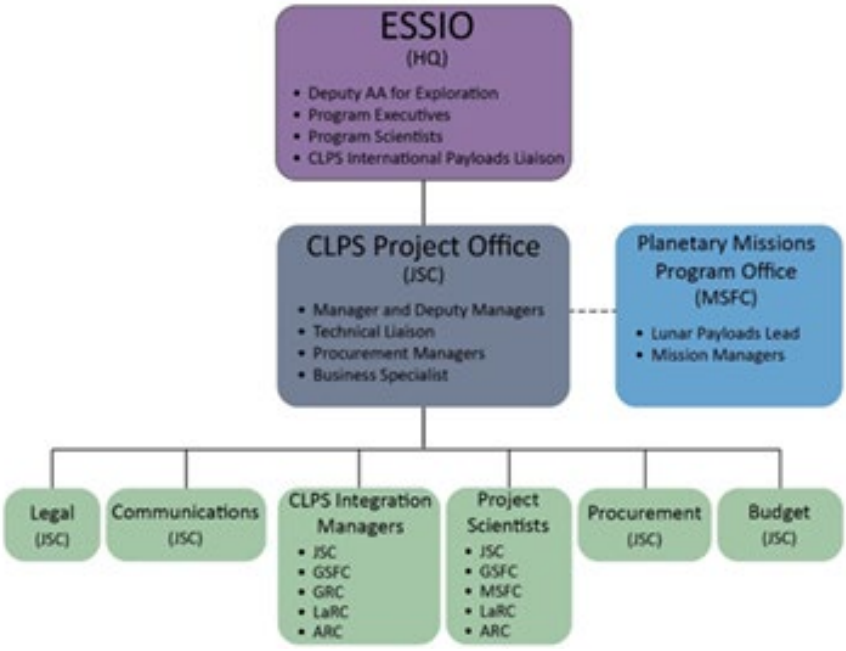

Figure 4: NASA CLPS Organizational Chart [Source: NASA OIG]