

Lunar Mission and Chandrayaan-3

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Abstract:

This article delves into the recent advancements made in lunar exploration, highlighting the technological advancements and scientific breakthroughs that have shaped lunar missions. From the deployment of sophisticated robotic probes to the soft landing of rovers, we explore the multifaceted objectives driving lunar exploration efforts. Additionally, the article addresses the challenges faced in navigating the harsh lunar environment, emphasizing the importance of sustainable and innovative solutions for future missions. As space agencies and private entities collaborate to unlock the Moon's mysteries, this article offers a comprehensive overview of the evolving landscape of lunar exploration and the potential implications for scientific discovery and future space endeavours.

Keywords: Chandrayaan-3, Lunar exploration, ISRO (Indian Space Research Organisation), Moon mission, Space technology, Lunar rover, Payloads, Space exploration, Moon landing, Lunar surface analysis, Lunar South Pole.

1. Introduction:

"That's one small step for man, one giant leap for mankind." — Neil Armstrong said as he stepped onto the moon. The moon is the closest celestial body of the earth, so no doubt many countries have tried to reach the moon. But only four countries have till now succeeded in soft landing on the moon. India has recently written its name in the pages of history by being the fourth country to soft land on the moon and the first to do so on the South Pole.

2. Global Lunar Mission:

As part of human exploration of the Moon, numerous space missions have been undertaken to study Earth's natural satellite. Of the Moon landings, Luna 2 of the Soviet Union was the first spacecraft to reach its surface successfully, intentionally impacting the Moon on 13 September 1959. In 1966, Luna 9 became the first spacecraft to achieve a controlled soft landing, while Luna

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10 became the first mission to enter orbit, and in 1968 Zond 5 became the first mission to carry lifeforms (tortoises) to close proximity of the Moon.

Between 1968 and 1972, crewed missions to the Moon were conducted by the United States as part of the Apollo program. Apollo 8 was the first crewed mission to enter orbit in December 1968, and it was followed by Apollo 10 in May 1969. Six missions landed humans on the Moon, beginning with Apollo 11 in July 1969, during which Neil Armstrong became the first person to walk on the Moon. Apollo 13 was intended to land; however, it was restricted to a flyby due to a malfunction aboard the spacecraft. All nine crewed missions returned safely to the Earth.

Country	Agency or company	Successful	Partial failure	Failure	Operational [clarification needed]	Total	Total for country
USSR	Lavochkin	16	2	22	-	40	58
	Energia	2	-	16	-	18	
USA USA	NASA	36	2	14	3	55	57
	USAF	1	-	1	÷	2	
China China	CNSA	7	-	-	5	7	7
• Japan	ISAS	2	-	2	-	4	5
	JAXA	1	-		-	1	
💳 India	ISRO	2	1	с.	2	3	3
EU	ESA	1	-	-	-	1	1
Luxembourg	LuxSpace	1		3	2	1	1
South Korea	KARI	1	-		1	1	1
USA (private company)	Lockheed Martin	1	-		-	1	1
USA (private company)	Fluid & Reason	1	-	-	-	1	1
📕 📕 italy	ASI	1	-		-	1	1
srael	SpaceIL		-	1	-	1	1
Russia	Roscosmos	-	-	1	-	1	1
UAE	UAESA	2	~	1	2	1	1
Japan (private company)	ispace	-	-	1	-	1	1

Analysis of numbers of lunar missions

Fig-1: Lunar Missions from around the world *Wikipedia*]¹

¹https://en.wikipedia.org/wiki/List_of_missions_to_the_Moon

3. Indian Mission about Lunar Mission

3.1 Chandrayaan-1 Mission:

Chandrayaan-1² was the first Indian lunar probe under the Chandrayaan programme. It was launched by the Indian Space Research Organization in October 2008, and operated until August 2009. It was launched to orbit the Moon and to dispatch an impactor to the surface.

3.2 Chandrayaan-2 Mission:

Chandrayaan-2³ is the second lunar exploration mission developed by the Indian Space Research organization, after Chandrayaan-1 in July 2019. The primary objectives of the Chandrayaan-2 lander were to illustrate the ability to soft-land and operate a robotic rover on the lunar surface. Sadly, this mission was unable to achieve its full objective but the orbiter is still functional and continues its 7-year mission. But the soft -landing failure of the Chandrayaan-2 on the moon surface has paved the way for the success of the Chandrayaan-3. The orbiter had played a role in **identifying a safe landing spot for Chandrayaan-3** and facilitated communications between the Chandrayaan-3 lander and the ground station.



Fig-2: Chandrayaan - 1⁴



Fig-3: Chandrayaan - 2⁵

4. Details about Chandrayaan-3 :

Chandrayaan-3⁶ is the third mission in the Chandrayaan programme, a series of lunar-exploration missions developed by the Indian Space Research organization. The mission launched on July 14, 2023, from the Satish Dhawan Space Centre in Sriharikota, India. The spacecraft entered lunar

² https://en.wikipedia.org/wiki/Chandrayaan-1

³ https://en.wikipedia.org/wiki/Chandrayaan-2

⁴ https://en.wikipedia.org/wiki/Chandrayaan-1

⁵ <u>https://www.isro.gov.in/Chandrayaan 2.html</u>

⁶https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4553155#:~:text=Abstract.pole%20on%20August%2023%2C %202023

orbit on August 5, 2023. On August 23, 2023, the lander successfully touched down near the Moon's south pole. The mission includes a lunar lander named Vikram and a lunar rover named Pragyan. The mission's goals are to demonstrate end-to-end landing and roving capabilities.



5. Output Revealed from the Lunar Mission & Chandrayaan-3

Some of the mission's scientific findings⁹ are its discovery of temperature drops just few inches below the surface. This temperature pattern suggests that future underground outposts could be well-insulated from surface temperature fluctuations. a seismometer on Vikram detected a possible moonquake, further advancing our understanding of lunar geology.

The rover, Pragyan, confirmed the presence of elements like aluminum, calcium, iron, and titanium, as well as the unexpected discovery of sulfur. The higher concentrations of sulfur in the Polar Regions indicate its potential utility in various technologies and industries, such as solar cells, batteries, and fertilizers.



Fig-6: Facts and Figures ¹⁰

⁷ <u>https://en.m.wikipedia.org/wiki/File:Chandrayaan-3_Lander.webp</u>

⁸ <u>https://axsx.in/isros-chandrayaan-3-mission-indias-third-lunar-mission/</u>

⁹ <u>https://www.indiatoday.in/science/chandrayaan-3/story/chandrayaan-3-how-it-changed-our-understanding-of-the-moon-2445370-2023-10-06</u>

¹⁰ <u>https://compass.rauias.com/current-affairs/chandrayaan-3/</u>

6. Future Planning for the Space Mission of India and other Countries:

The future of space exploration¹¹ involves both telescopic exploration and the physical exploration of space by robotic spacecraft and human spaceflight.

Near-term physical exploration missions, focused on obtaining new information about the Solar System, are planned and announced by both national and private organizations. There are tentative plans for crewed orbital and landing missions to the Moon and Mars to establish scientific outposts that will later enable permanent and self-sufficient settlements. Further exploration will potentially involve expedition and the other planets and settlements on the Moon as well as establishing mining and fueling outposts, particularly in the asteroid belt. Physical exploration outside the Solar System will be robotic for the foreseeable future.

7. India's Growing Space Wings:

7.1 Space Stations so far:

- Salyut 1 | World's 1st space stn, launched in 1971 by USSR, which sent several others in following years, ending with Mir (launched 1986, in space till 2001)
- Skylab | 1st & only station launched exclusively by US
- > Int'l Space Station | In orbit since 1998. Joint project of US, Russia, Europe, Canada & Japan
- > Tiangong 1, 2 & Tiangong (permanent stn) | Launched by China in 2011, 2016 & 2021
- India's Station | 20-tonne station orbiting at 400km above Earth that'll likely kely host Indian astronauts for 15-20 days at a time. Originally planned for 2030

7.2 Destination Moon:

- 12 humans, all US male astronauts, have so far walked on Moon. Last person was Harrison H Schmitt in 1972
- ▶ US, China & Russia have proposed crewed lunar missions in next decade or so

7.3 India's Plan:

After success of Chandrayaan-3, Isro plans series of lunar missions, including one with Japan. Plans sending Indians to Moon after putting its 1st astronaut(s) in space under the Gaganyaan programme

¹¹<u>https://en.wikipedia.org/wiki/Future_of_space_exploration#:~:text=Further%20exploration%20will%20potentially</u> %20involve,robotic%20for%20the%20foreseeable%20future.

8. Conclusion:

The Chandrayaan-3 mission ¹², India's first successful space mission to the moon's surface, concluded recently after its lander and rover could not be revived from the cold lunar darkness. Despite this outcome, the mission accomplished its goals and provided valuable scientific insights. After completing their observations, mission controllers sent commands to put Vikram and Pragyan to sleep to conserve energy during the approaching lunar night. The spacecraft were not designed to withstand the extreme cold temperatures during the night, leading to their inability to be revived. However, the mission can still be considered a success for the Indian Space Research Organization (ISRO). Chandrayaan-3's safe landing and scientific observations showcased India's growing capabilities in space exploration. It also redeemed the disappointment of the failed Chandrayaan-2 mission four years ago.

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¹²https://ts2.space/en/the-conclusion-of-indias-chandrayaan-3-mission-and-its-achievements/#gsc.tab=0