Literature Review on A Comparative study on Chandrayaan missions (Lunar Space Exploration by Indian Space Research Association)

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I. INTRODUCTION

ISRO is a space agency under the Indian Ministry of Space, headquartered in Bengaluru, Karnataka. Indian Space Research Organization has a vision to use space technology for the development of the country and at the same time carry out space science research and planetary exploration. ISRO was established on August 15,1969. Its main objective was **"to use space technology for national development through space science research and planetary exploration"**. The CEO of ISRO is also the President of the Space Commission of Government of India and the Minister of Space. In 1962, India's first prime minister Jawaharlal Nehru established the Indian National Commission for Space Research, also known as INCOSPAR. INCOSPAR is involved in Indian space exploration. It was directed by Vikram Sarabhai. He was the founder of India's space program. ISRO replaced INCOSPAR in 1969. Six years after its founding, India launched its first Aryabhata satellite into orbit. The satellite was launched into orbit by a Soviet rocket. Development of ISRO for the growth of our nation: The Indian space research organization is no longer limited to launching satellites, but has steadily increased its role in development, thereby contributing to the Prime Minister's mission to Transform India.

In agriculture, ISRO technology is now also being used to carry out crop production forecasts for at least eight major crops, including wheat, kharif and rabi rice, mustard, jute, cotton, sugarcane, rabi sorghum and rabi pulses.

In the railway industry, applications of space technology have been realized in recent years in guarding unmanned railway crossings, detecting obstacles on the railway to prevent train accidents and other similar activities.

Satellite imagery is now being used to monitor India's borders and check foreign incursions. ISRO and the space ministry have already overtaken several other countries in their space endeavors, and images from missions like the Mars OrbiterMission (MOM) are now being used even by leading space centres.

Need to explore the moon ?

Many people think that the moon is just a gray ball of rock in our sky. Surprisingly,many scientists seem to share this notion. I once had a physicist tell me that the moon is scientifically boring. They could not be far from the truth. during the early solar system roughly four billion years ago asteroids and comets have been bombarding planets and their moon at a vigorous pace most craters formed from such impacts on earth are no longer visible due to erratic by wind and water but the moon being wide of such processes have preserved most of the craters in the same condition for million and million of years. This curiosity among humans led to exploration of planet moon.

Figure 1: Surface of Moon

Preparation for Mission Chandrayaan 1

In Sanskrit, Chandrayaan means moon boat. This is the satellite that went to the moon. This is ISRO's first Moon Probe. It was launched from the Satish Dhawan Space Centre, released on October 20, 2008. The task lasted 2 years. The recycler also released an impactor that was deliberately dropped on the Moon, releasing debris that was analyzed by science instruments on the orbiting spacecraft.

Rocket used

The mission included a lunar orbiter and impactor. India launched the PSLV-XL spacecraft on October 22, 2008 at 00:52 UTC from the Satish Dhawan Space Center in Sriharikota, Andhra Pradesh.

Cost of Mission

The cost of the mission Chandrayaan is Rs.368 crore.

Specification of mission of Chandrayaan 1

launch mass	**1380 kg**
dry mass	**560 kg**
payload mass	**105 kg**
manufactured by	**ISRO**
launch date	**22 October 2008**
mission duration	**2 years**

Merits and Demerits of Chandrayaan 1

Scientists speculate that frozen water near the moon's south pole could be used for a variety of purposes, including making rocket fuel, drinking water, producing oxygen, and growing crops.In August 2009, Chandrayaan-1 lost contact with ground stations while hovering 200 km above the lunar surface. After some time, ISRO officially declared the mission over. The spacecraft's lifespan was expected to be two years, but a number of technical issues, including star sensor failure and an inadequate heat shield, reduced the spacecraft's lifespan to just 312 days. However, 95% of the mission objectives have already been achieved.This project was a huge step forward not only for ISRO but also for the world.It paved the way for future lunar exploration.After the success of Chandrayaan 1, the way was paved for Chandrayaan 2

Overview of Chandrayaan 2 over 1

In contrast to Chandrayaan-1, Chandrayaan-2 aimed to gently land its Vikram module on the moon and sends Pragyaan, a six-wheeled rover, there to conduct a number of scientific investigations. While Chandrayaan-2 weighed 3850 kg, Chandrayaan-1 had a lift-off mass subsequently of 1380 kg. Chandrayaan-2, which failed to achieve the desired soft landing in September 2019. It was meant to exhibit a range of capabilities, including reaching the moon's orbit, making a soft landing over its south pole using a lander and, a rover studying the surface.

Overview of Chandrayaan 3 over Chandrayaan 2 ?

At the time of Chandrayaan-2, the rover and the lander had crashed on the lunar surface, rather than landing softly. The chairperson explained that the main issue behind such a landing was that the five engines on the lander gave a slightly greater thrust than expected. To determine the site of the landing, the lander had to click images by remaining stable during the period. That is when the errors took place.

The current mission however is designed after considering all these errors.

The very first change that deserves attention is that the landing area has been expanded. Rather than attempting to reach a set 500mx500m patch for landing as done by the previous Chandrayaan-2, the present mission has been instructed to make a safe landing anywhere in an area of 4kmx2.4km.

Another aspect that comes into focus is the landing site. Chandrayaan 2 landed on the moon's near side, while Chandrayaan 3 is created to land on the moon's South Pole. The South Pole is a very important region for lunar exploration, as it is thought to be rich in water ice.

Finally, Chandrayaan 3 will be a more autonomous mission than Chandrayaan 2. The lander and rover on Chandrayaan 3 will be able to operate more independently, as there will be no human intervention possible once they land on the moon.

Objectives of Chandrayaan 3 Mission

The goal of Chandrayaan-3 was to demonstrate a safe and soft landing on the lunar surface, demonstrate the spacecraft on the lunar surface, and conduct on-site scientific experiments.

Preparation for Mission Chandrayaan 3

The main scientific experiments planned after the lander's successful landing onthe moon include

(i) The study of lunar surface vibrations caused by seismic phenomena, meteorite impacts, rover movement, etc.

; -Surface plasma environment

(ii) Temperature and thermal conductivity to a depth of 10 cm

(iii) Elemental composition of the landing site and its surroundings

(iv) Spectral characteristics of the Earth from lunar orbit

Rocket used for Chandrayaan 3

Chandrayaan-3 was loaded onto her LVM3-M4 rocket from the second launch site of the Satish Dhawan Space Center in Sriharikota, Andhra Pradesh, India, on July 14, 2023 at 09: 05 UTC. It was launched and entered orbit around the Earth at perigee 170 km (106 miles), 36,500 km (22,680 miles) at peak

Cost of mission

The cost of Chandrayaan 3 was 600 crores.

Specification of mission of Chandrayaan 3

The mission consists of a landing module, a propulsion module, and a rover. The payload of the propulsion module is the Habitable Planet Earth Spectropolarimeter (SHAPE). SHAPE aims to study the habitability of exoplanets by examining reflected light . The payload of the Vikram lander is: Chandra Surface Thermophysical Experiment (ChaSTE) to measure thermal conductivity and temperature Lunar Seismic Activity Instrument (ILSA) to measure seismic activity around the landing site Langmuir spacecraft to estimate plasma (LP) density and its variations NASA Passive Laser Retroreflector Array for Lunar Laser Ranging Research The payloads of the Pragyan spacecraft are: Alpha Particle X-ray Spectrometer (APXS) Laser-Induced Breakthrough Spectroscopy. The data contained in the LIBS Advanced Technology payload will aid scientific experiments on the Moon . Mission duration is 1 lunar day or 14 Earth days

launch mass	**3896 kg**
dry mass	**448 kg**
manufactured by	**ISRO**
launch date	**14 July 2023**
mission duration	**14 Earth days**
mission's lander	**Vikram**
rover	**Pragyan**

Figure 2: Chandrayaan -3

Chandrayaan 3 accomplishments

Chandrayaan-3 is India's lunar exploration mission that successfully made a soft landing on the moon's surface on August 23, 2023 , National Space Day is celebrated on August 23 every year to commemorate the successful landing of Chandriana-3 , Chandrayaan-3, which follows Chandrayaan-1 and Chandrayaan-2, is expected to demonstrate India's technological prowess in predictive exploration of the Moon. Equipped with advanced instruments, the Prayan spacecraft conducted scientific research, analyzed the lunar soil, and collected important data for research. The rover entered sleep mode on September 2, 2023 Chandrayaan-3 is a testament to India's commitment to space exploration and deepening ourunderstanding of the mysteries of the moon.

Comparison

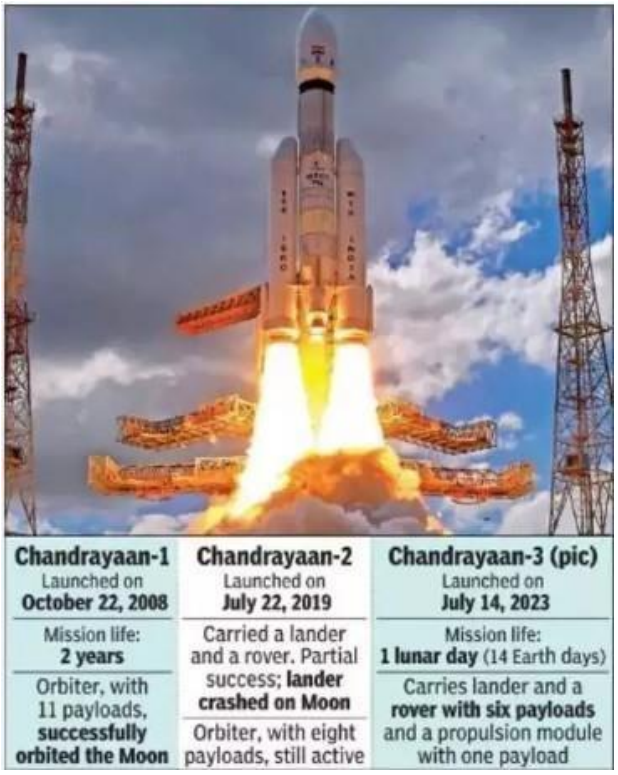

Figure 3: Comparative analysis

Future Scopes

The Chandrayaan-3 mission is a complex and challenging task, requiring the expertise of data scientists.They can contribute to the mission by developing more models for safe landing, identifying lunar soil substances, planning future missions, developing software, managing data, and communicating results to the public. Data scientists can also help develop the overall mission strategy, troubleshoot problems, and ensure the missions are completed on time and within budgets. As the field of data science evolves, data scientists are expected to play a larger role in future missions to the moon and beyond. Collaboration with other scientists and engineers is crucial for the success of this mission.

Conclusion

The moon's rotation, which lasts for roughly 28 days on Earth, causes the lunar night. Similar to how Earth's tilt

causes it to have longer summer days and shorter winter days, the moon rotates with half of its surface in direct sunlight and the other half in complete darkness.
Chandrayaan-3 has been a major success for India. India is now the fourth nation to land on the moon successfully, showcasing its ability to travel and land safely on the lunar surface. The mission has garnered international attention as well because of the possible riches in the moon's South Pole region, which several nations and corporate enterprises are eager to explore.

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