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Q7

India has achieved remarkable successes in unmanned space missions including the Chandrayaan and Mars Orbiter Mission, but has not ventured into manned space mission, both in terms of technology and logistics? Explain critically.

UPSC Civil Services Mains 2017 · GS III · 10 marks · Indian Economy

Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.

Core demand of the question

- Explain India's success in unmanned missions such as Chandrayaan and the **Mars Orbiter Mission**
- Critically explain why a manned mission has not been undertaken in technology and logistics

Revision summary

Chandrayaan-1 mapped the Moon and supported lunar water-related findings; MOM reached Mars orbit in 2014 on a PSLV-class budget.

Unmanned probes can fail without loss of life; crew flight cannot.

India still needed a human-rated heavy launcher, life support, abort, and qualified re-entry after **CARE 2014**.

Recovery ships, medicine and tracking are logistics that an orbiter does not need.

The delay is both remaining technology and a choice to fund earth and planetary robots first.

Introduction

The **Indian Space Research Organisation** showed that a developing country can do **deep-space science** at low cost. **Chandrayaan-1** (2008) and the **Mars Orbiter Mission** (Mangalyaan, 2013-14) are unmanned successes. A **human spaceflight** needs a different stack: crew safety, life support, abort, re-entry and recovery. India had building blocks by 2017. It had not yet accepted the cost and the remaining technology risk of putting a crew in orbit.

Body**Unmanned successes**

- **Chandrayaan-1** orbited the Moon, mapped minerals, and, with the Moon Impact Probe and NASA's Moon Mineralogy Mapper, contributed to the detection of **lunar water/hydroxyl** signatures.
- It used a **PSLV** launch and a modest spacecraft mass, proving lunar transfer without a heavy-lift culture like NASA's Apollo-era budget.
- **Mars Orbiter Mission** reached Martian orbit in September 2014 on a **PSLV-XL** and a carefully timed Hohmann-like path; it was among the cheapest successful Mars orbiters and

worked on the first attempt.

- Unmanned work also includes **INSAT/GSAT** communications, **IRS** earth observation, **navigation (NavIC)**, and planetary planning for a second lunar mission.
- These missions tolerate **loss of a probe**. They do not require a human-rated launcher, a crew module that can abort, or a medical recovery chain.

Why manned flight lagged: technology

- A crew needs a **human-rated launch vehicle** with reliability far above a typical PSLV/GSLV cargo flight; **GSLV Mk III** (later LVM3) was only then proving a heavier cryogenic launcher.
- **Life support** (oxygen, carbon dioxide, thermal control, waste) and **radiation** shielding for even a short low-earth orbit stay were not operational systems.
- **Re-entry** of a crew capsule at orbital speed, with a reliable heat shield and parachutes over Indian waters, was still at test stage: the **Crew Module Atmospheric Re-entry Experiment (CARE, 2014)** was a first step, not a qualified spaceship.
- **Launch escape / pad abort**, spacesuits, crew training, and human-rating of avionics add years after an unmanned orbiter succeeds.
- Docking, extra-vehicular activity and a space station are further rungs India had not climbed; even a short autonomous orbit is a large jump from Mangalyaan.

Logistics and a critical view

- Logistics include **recovery ships**, hospitals, a crew selection pipeline, and a ground tracking network that must not fail during a few-minute re-entry window.
- **Cost and opportunity**: the same rupees buy many remote-sensing and navigation satellites that serve farmers, disaster managers and the military; a human mission is politically visible but economically heavier.
- ISRO's culture of **frugal unmanned science** was a strength; it also meant human spaceflight was not the organisational priority until capacity and a political go-ahead aligned.
- Critically, the gap is **real in crew safety engineering**, not a myth. It is also a **choice**: Russia, the United States and China spent decades and lives on that ladder. India could still fly humans later without having failed as a space power in 2017.
- Dependence on foreign human-rating know-how would raise **strategic autonomy** questions; building it in-house takes time after CARE-type tests.

Flow diagram

Unmanned Chandrayaan MOM -> Science at low cost
Manned needs -> Life support abort re-entry
Manned needs -> Human-rated launcher
Manned needs -> Recovery logistics
CARE 2014 tests -> Manned needs
Budget priority satellites -> No crew mission yet

Conclusion

Chandrayaan-1 and the **Mars Orbiter Mission** proved unmanned lunar and interplanetary skill at low cost. Manned flight had not followed because human-rating, life support, abort and recovery were incomplete, and because logistics and budget favoured satellites over a crew. The lag is both a technology gap and a rational sequencing choice, not proof that India cannot eventually fly a crew.

Facts & figures

Chandrayaan-1

ISRO lunar orbiter, 2008: mineral mapping and contribution to evidence of water/hydroxyl on the Moon.

Mars Orbiter Mission

Mangalyaan, launched November 2013, Mars orbit September 2014: India's first interplanetary success, noted for low cost and first-attempt orbit.

CARE 2014

Crew Module Atmospheric Re-entry Experiment on LVM3/GSLV Mk III experimental flight: early test of a crew-capsule shape, not a manned mission.

PSLV / GSLV Mk III

Workhorse polar launcher versus the heavier cryogenic vehicle needed to lift a future crew module; human-rating is an extra standard.

NavIC / IRS / INSAT

Operational unmanned programmes in navigation, earth observation and communications that compete for the same ISRO budget as a human flight.

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