Mangalyaan Mission – Timeline, Launch Details, Findings

July 10, 2026 • vajiramandravi.com

India's maiden interplanetary mission, the **Mars Orbiter Mission (MOM)**, also called **Mangalyaan**, marked a major milestone in its space program. Launched in November 2013 by the Indian Space Research Organisation (ISRO), Mangalyaan created history by successfully entering Mars orbit on its very first attempt.

Key objectives included demonstrating India's capability to reach Mars orbit and conducting scientific studies on **Mars' surface features, morphology, minerals and atmosphere**. The Mangalyaan mission is considered historic for being India's maiden interplanetary voyage executed in the very first attempt. It put India in an elite club of global space agencies with expertise in Mars exploration.

Mission Mangalyaan - Launch Details and Timeline

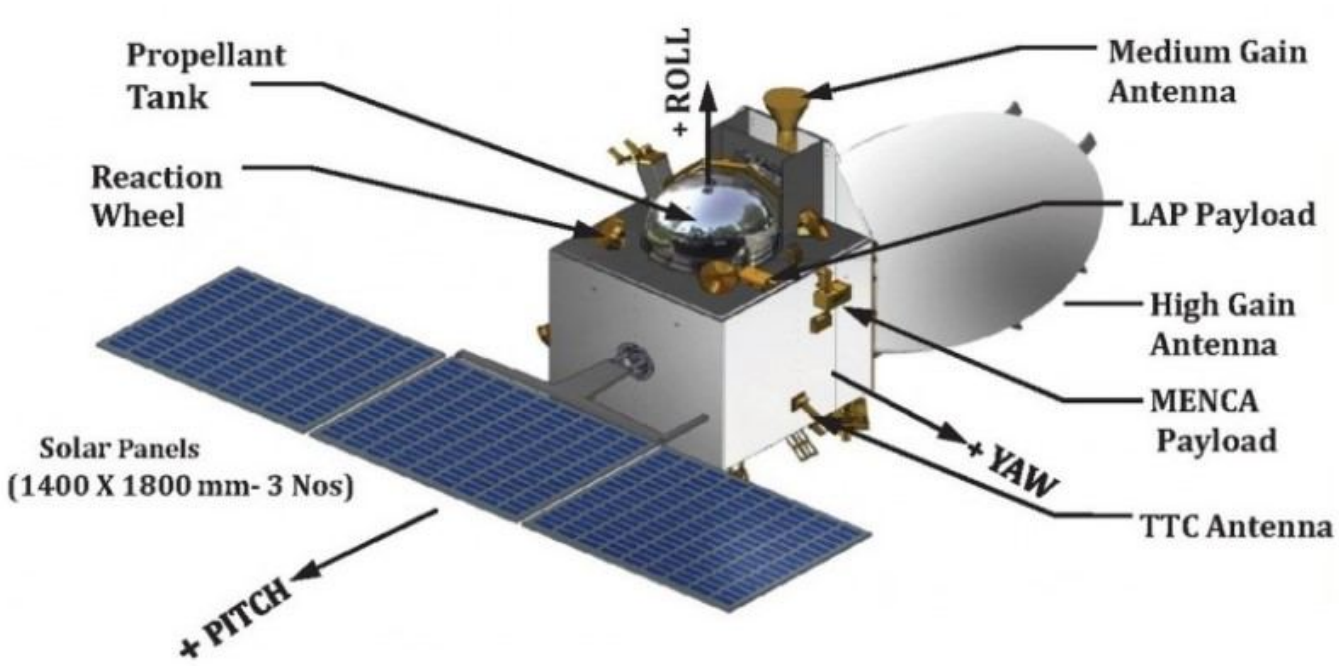
The launch and insertion phase required very precise manoeuvres by Mangalyaan involving both terrestrial and deep space navigation over 10 months:

- Mangalyaan was launched aboard a **Polar Satellite Launch Vehicle (PSLV C25)** rocket from **Satish Dhawan Space Centre at Sriharikota, Andhra Pradesh.**

- The spacecraft spent over **300 days** cruising in deep space before entering Mars orbit on September 24, 2014. This was achieved in the very first attempt - a historic first for any Asian space agency.
- Initially planned as a **6-month mission,** MOM completed **8 years in Mars orbit** on September 24, 2022 - well beyond its designed mission life.

Parts of the Mangalyaan Mission

After entering orbit, the scientific phase involved Mangalyaan started collecting data through five onboard payloads to study Mars' surface, atmosphere and mineralogy.



- **Orbiter:**
  - Mangalyaan orbiter weighed **1337 kg** with a lift-off mass of 1340 kg from Earth.
  - It had a **cuboid structure** with solar panels attached to facilitate power generation.

- **Payloads:** The orbiter had 5 payloads to conduct scientific studies using multiple instruments. These include:
    - **Mars Color Camera**: To capture images and information about Martian surface features and processes.
    - **Methane Sensor for Mars**: To detect the presence of **methane** which would provide evidence of Martian life.
    - **Mars Exospheric Neutral Composition Analyser**: To study the composition of the planet's **upper atmosphere.**
    - **Thermal Infrared Imaging Spectrometer**: To map surface composition and mineralogy of Mars.
    - **Lyman Alpha Photometer**: To measure the relative abundance of **deuterium and hydrogen** from **Lyman-alpha emission** in Mars' exosphere.
- **Objectives:**
    - **Scientific**: Mangalyaan was developed to build deep space exploration capabilities and conduct a study of the Martian surface features, morphology, mineralogy, and the atmosphere as well as to study extraterrestrial life.
    - **Technological:** It aimed to develop, test and validate the state-of-the-art technologies capable of operating with sufficient autonomy in the journey phase of interplanetary travel.

Scientific Findings of Mars Orbiter Mission

During the extended mission phase spanning over 8 years, the MOM payloads have contributed important Martian observations:

- **Atmospheric Methane Detection:** Methane Sensor for Mars made the first clear detections of Martian methane **(a potential indicator of microbial life)** in September 2014 raising prospects of potential biological links that warrant deeper investigation to isolate sources.
- **Surface Imaging:** High-resolution images from the Mars Colour Camera delivered extensive visual data on Martian surface features like **craters, valleys, dunes, ice caps** and **weather systems** facilitating a better understanding of surface morphology and dynamics.
- **Mineralogical mapping: Thermal Infrared Imaging Spectrometer** generated mineral composition maps of Mars surface showing distributions of **clay, hematite, silicates** etc tied to past aqueous alteration processes providing clues to palaeoclimatic conditions.
- **Upper atmospheric insights: MENCA mass spectrometer** facilitated precise quantification of the extent of **Argon-40** in Mars atmosphere - a tracer isotope giving clues on atmospheric loss to space.

Mission Mangalyaan Challenges and Solutions

Despite meticulous planning, the Mangalyaan mission team also had to overcome key challenges during the long voyage and continuing orbital phase:

- **Communication time delay:** Earth-Mars distance of **200 to 400 million kilometres** implies a one-way radio signal delay of at least **4 to 20 minutes** demanding reliance on **automated fault detection, diagnosis,** and **correction** capabilities without ground control guidance.

- **Propulsion needs:** Lack of onboard propulsion system implied trajectories had to be perfectly pre-calculated including factors like **slingshot manoeuvres.**
    - **Mid-course corrections** were done using short thruster bursts.
- **Solar conjunctions:** When Mars goes behind the Sun relative to Earth, **ionized solar plasma** can interfere with signals. So special automated contingency procedures were formulated.

Mission Mangalyaan made core improvements in **automation, autonomy** and **onboard decision-making functions** to resolve situations without immediate ground control while advancing deep space communication abilities.

Significance of Mangalyaan Mission

The success of Mangalyaan had wide-ranging impacts on the trajectory of India's space program:

- **Mastering Interplanetary Skills:** Highly complex coordination to complete manufacture, assembly, integration, testing, launch and spaceflight operations within **18 months** reflected robust mission engineering skills.
- **Platform for advanced exploration**: Operational validations of enhanced spacecraft technologies will lay the foundations for highly capable Mars missions in the 2030s timeframe involving attempting historic landing and roving milestones.
    - Boosted priority for space exploration leading to approval of subsequent proposals like Chandrayaan-2, Aditya L1, Shukrayaan-1, etc.
- **Spur commercial space activity**: The mission's result will highlight the proven reliability of India's space technology for global customers while catalysing both international partnerships and the domestic private space industry.
- **Cost reduction:** Economically executed mission **(4.5bn rupees)** using limited engine firings and optimised for fuel, weight etc won international acclaim, contrasted to contemporary **NASA MAVEN orbiter's 10 times higher price tag**.
- **Global leadership:** India is staking leadership among developing countries rather than mimicking other agencies in advancing Martian exploration.
    - Entry into the elite league of space agencies mastering expertise in Mars travel boosting global standing significantly.

Global Mars Missions

Since the first successful **flyby in 1965,** several space agencies have successfully made it to Mars such as:-

Mission Name	Key Highlights	Current Status
Mars Express- European Space Agency (2003)	- The first European mission to Mars; found evidence of methane and ammonia	- Operational since 2004, extended until the end of 2022

Curiosity-NASA (2011)	- Rover analysed geology & climate; and found evidence ancient lakes could have supported life	- Active and mobile on Mars
MAVEN- NASA (2013)	- Orbits Mars studying atmosphere & climate history	- Operational, has helped relay data from rovers
ExoMars Trace Gas Orbiter - European Space Agency/Russia (2016)	- Studies atmospheric gases like methane; relays data from rovers	- Operational at Mars, has detected **'unusually high' methane levels**
InSight lander- NASA (2018)	- Geology mission assessing seismic activity on Mars	- Operational on Mars surface, has recorded over 500 marsquakes so far
Hope Mars Mission- United Arab Emirates (2020)	- First interplanetary mission by Arab country; atmospheric studies	- Successfully entered Mars orbit in 2021
Tianwen-1- China (2020)	- China's first independent Mars mission containing orbiter, lander and rover	- **Rover Zhurong** operational on Mars surface after 2021 landing
Mars 2020 - Perseverance Rover- NASA (2020)	- Seeks ancient signs of life; carrying Ingenuity helicopter drone	- Operational on Mars; has recorded archaeological sites, Ingenuity completed flights

Mangalyaan 2

The Mangalyaan-2 mission is set to explore Mars and will carry **four payloads** to study various aspects of the red planet. These payloads include-

- The Mars Orbit Dust Experiment (MODEX),
- Radio Occultation (RO) experiment,
- Energetic Ion Spectrometer (EIS), and
- Langmuir Probe and Electric Field Experiment (LPEX).

The study will focus on the **Martian atmosphere, environment, and interplanetary dust.**
